THE

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THE

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WIRELESS TELEGRAPHY AND WAR CORRESPONDENCE.

THE lecture delivered by Capt. Lionel James at the Society of Arts last week will form an important chapter in the history of telegraphy. The events which, with such dramatic effect, have marked the progress of the war in the Far East, have been made known by the Press, through the agency of the telegraph services, with a degree of accuracy and rapidity which, even to those of us whose lives are particularly associated with the engines and munitions of electric signalling, appears ever mysterious and wonderful. Mystery and wonder reached, perhaps, their zenith when, in March, the *Times* eclipsed even its own records by publishing here in London an account of the doings of the belligerents in the China Sea, but a few hours after their occurrence. This appealed to us then; but now that the methods, difficulties, and other attendant circumstances of the transmission have been made known by the *Times* war correspondent, Capt. James, who was responsible at the point of origin, we must redouble our congratulations, both to him, the *Times*, and the cable service, for this masterpiece of telegraphic art.

We purposely refer to it as art, because Mr. Cuthbert Hall, after Capt. James's lecture, expressed surprise that the Society of Arts should entertain papers such as that just read by Capt. James. Mr. Hall's argument was that Capt. James had communicated a paper, the value of which, in the estimation of Mr. Hall, was to be found, not in its bearing upon wireless telegraphy as a science, but in the nature of the news transmitted by wireless telegraphy. He followed up this acid remark by suggesting that the wireless results obtained by the De Forest system in no respect transcended those previously obtained by the Marconi system, and he affected to be at a loss to gather exactly to what part of the wireless results referred to by the lecturer special significance was to be attached. If it was the *distance* traversed, it was common knowledge, he said, that messages were sent by the Marconi system over distances of 1,500 miles; and if it was the *number of words* sent, again it was well known that thousands of words were sent daily by the Marconi system. On this latter point Mr. Hall was reminded by another speaker, that the fact that thousands of words might be sent daily by a given system was no evidence of its merit, and that the true test of rival systems was determined by the relative *rates* at which words were correctly received. The lecturer left no doubt upon the question in his reply. He said he selected the De Forest system after judging results, which he had had an opportunity of doing at the yacht race the year before. Both in regard to freedom from interruption by other transmitting stations, and in regard to the speed and accuracy with which messages could be received, he had observed that the De Forest system was superior to its rivals. He declared

that the only interruption that they ever had to the apparatus on board of the *Haimun* was caused by a static discharge; and that, so long as they kept at a distance greater than 1 mile from other transmitting stations, they suffered no inconvenience. Within 1 mile, they had a word or two "mixed up by foreign sparks from other systems." They worked over distances varying from 70 to 150 miles, with the Italian, Russian and Japanese systems working hard all round, but making no difference to their messages. Capt. James then observed that he had no means of judging whether the transmitter on the *Haimun* affected other stations, but that whenever they had reason to believe that the belligerents were signalling, his station refrained from transmitting. This freedom from interruption of his messages was the first reason for his having selected the De Forest system, and the second was that by this system he was able to transmit from 30 to 35 words a minute, against the 12 or 15 words of any other wireless system. Facts as striking as these must have struck Mr. Hall as being rather more than a reply to his quibble, for the merits of the Marconi system were here clearly outdone in regard to both syntony and speed. Almost involuntarily, as Capt. James spoke, our thoughts wandered back to the lecture given in May, 1901, before that same Society of Arts, by Mr. Marconi; and we remembered his all-too-early announcement that his efforts to secure syntony had been "crowned with complete success." And it seemed to us that if it was proper that the Society of Arts should accept a paper from Mr. Marconi wherein such a possibility was prematurely adumbrated, it was certainly proper, four years later, that the Society of Arts should welcome a communication from Capt. James wherein it was proved that the hope had brightened into so near an approach to accomplished perfection. But it is not difficult to understand Mr. Hall's objection to the character of the lecture.

The chief points of technical interest were those to which we have referred. Incidentally the lecturer gave a little information about the transmitting and receiving stations. Dr. De Forest had promised him that if he succeeded in erecting a mast 180 ft. in height on the China coast and used it in conjunction with a movable station which showed an exposure of at least 120 ft. of wire, he would supply him with a set of apparatus and expert operators who would transmit messages with accuracy for 160 miles. His receiving station was set up at Wei-hai-Wei, and his transmitting apparatus was fitted in the *Times* dispatch boat, the *Haimun*, provided with special spars. There were practical difficulties which prevented the carrying out of the arrangements first proposed, but they appear to have surmounted most of them. For their shore station they had chosen an island at the mouth of the bay at Wei-hai-Wei Harbour, which gave them a clear arc of open sea of about 135°. This position, however, obliged them to erect a station about 300 ft. above sea level. The disadvantage was dealt with by placing copper plates in the sea and connecting them to the sending apparatus. Unfortunately, the length of wire exposed on the transmitting station was 50 ft. less than that on the shore station, so that they were never able to receive at quite the same distance as they were able to transmit. They encountered rough weather, they had their signalling masts repeatedly broken, they traversed a sea all perilous with submerged mines, they ran a grave risk of being mistaken and torpedoed as a disguised war vessel, they were threatened by the Russians, and were finally constrained to relinquish their task by the Japanese, but they established a record in the transmission of war news, and they will occupy a proud position in the history of telegraphy.

Turning to the file of the *Times*, we find that a message was published in their columns on March 14th, from their "Special Correspondent"; it is marked "By the *Times* steamer *Haimun*," and is dated, "Seoul, March 11th, *viâ* Wei-hai-Wei." Similarly, we find a message from the same source published on March 15th, dated March 12th. These dates give us an indication of the time occupied by the ordinary cable service for telegrams. In contrast with these, we find on March 16th a message from their "Special Correspondent," which is marked, "By De Forest's Wireless Telegraphy, *viâ* Wei-hai-Wei, March 15th, 10.5 a.m." Even allowing for the difference in the clocks, and assuming that they were sent as special service telegrams, the performance does credit alike to the De Forest system, and to the cable systems concerned. The *Times*, however, exceeded this record on March 21st, by publishing a telegram marked, "By De Forest's Wireless Telegraphy. With the Japanese Fleet, *viâ* Wei-hai-Wei," and dated "March 20th, 11.50 p.m." This telegram, which, we understand, was transmitted with complete accuracy, occupies rather more than a column of the *Times*, and gives details of the fighting on March 10th, and the bombardment of Vladivostok. On March 24th we find a telegram from Chemulpo, to the effect that the receiving mast had broken down, but by the 26th we trace the *Haimun* again at sea telegraphing the position of the ill-fated Russian battleships, and on the 27th informing the breakfast tables of the world of the attack upon Port Arthur by the Japanese Fleet, and the completion of the landing operations at Chi-nam-po.

This rapid review of the work done by the *Haimun* in that period serves to show at once the value and the danger of a floating wireless telegraph plant within the fighting limits. The area covered is the entire field of naval action, the velocity of transmission is at least equal to that of the belligerents' systems, and the possibility of censorship is remote. Assuming the war correspondent to be neutral, and assuming that he is desirous, as in the case before us, to carry out his work as becomes a gentleman, yet it is obvious that he has no means of knowing exactly what to withhold from his friend the enemy. It is tolerably certain, therefore, that in all future wars wireless telegraphy will be denied to war correspondents, officially. But it is also tolerably certain that it will be used by them, unofficially. On this point Capt. James said that "if a man has nerve enough to run blockades, he will have nerve enough to carry wireless telegraphy with him."

The Cudworth Accident.

THE lamentable railway accident at Cudworth, on the Midland Railway, last week, involving considerable loss of life and injury to the person, is another of the instances which periodically occur to remind the public of the hidden dangers of railway travelling under the exceptional conditions of weather to which we are somewhat liable in this country, and illustrates vividly the necessity for interdependence between the various classes of signalling apparatus used, and the absolute dependence upon efficiency in every link of the complex chain of railway signalling, if the safety of the travelling public is to be ensured.

At the time of writing, the only reports of the occurrence and the causes leading up to it are those of the daily Press. Whilst such reports are not in all cases absolutely reliable, the accounts are sufficiently circumstantial to enable the circumstances existing to be inferred. The occurrence undoubtedly took place during a very bad fog, which effectually prevented the drivers from seeing the ordinary signals, and naturally led them to rely upon the establishment of the ordinary fog-signalling arrangements. Apparently, no such signals were obtained by the drivers of the express, and, following the statements in the daily papers, we find that the fog signalman appointed to the signals protecting the point where the collision occurred did not reach his position in time to commence his duties until after the express had passed.

Here, then, we have the crux of the conditions leading to this most important accident. The occurrence was not due to any failure of apparatus, so far as is ascertainable at present, but to a failure of the arrangements to get the men to their positions in time. Fog signalling, of course, is of most irregular occurrence, and it is usual to withdraw men from other duties to take charge of it during ordinary working hours, or from their homes, if the necessity arises

after the men have completed their day's work. In the interval between the decision to commence fog-signalling, and the time when such signalling is actually commenced, the arrangements are necessarily incomplete, although the ordinary signalmen have instructions with reference to such a period. In this particular case, however, what is to be noted is the break in the arrangements for meeting the conditions imposed by rapid development of the fog, and as a corollary, the vital necessity for making such arrangements, or providing such apparatus, as will meet the known exigencies in future cases.

The present arrangements for fog signalling are, as has been frequently pointed out in these columns, antiquated and out of touch with the requirements of the times. Whilst perfectly satisfactory for the more leisurely working of railways prevalent during the seventies of last century, they are not adapted to the ideas of working and time-keeping held by the business departments of railways, or by passengers, at the present time. Their defects are numerous, and not the least defect is that which has led to the accident now under consideration.

From time to time, apparatus intended to obviate the well-known defects of fog signalling, as now carried on, have been illustrated and described in these columns, and of late years much activity has been shown by inventors in attempting to cope with the conditions obtaining. Probably those which have the appearance of being most suitable for supplementing the ordinary signalling, in lieu of the explosive detonator, are those which aim at reproducing upon the engine, under sure and certain notice of the driver, the signals exhibited at the side of the line. Whilst it cannot be said that absolute success has been obtained by any of the systems yet published, so far as *complete repetition* is concerned, yet a certain amount of progress has been made in familiarising the minds of those concerned with what is, to a large extent, a revolutionary idea. Such apparatus, too, has already been adopted to a limited extent, as with Raven's on the North-Eastern Railway, where it has been adopted with—to some extent—a view to its uses in connection with such automatic signalling as is in use between Alne and Thirsk on the main line. Where, however, the effects are produced by impact between stationary objects on the line and apparatus carried upon the engine, it is to be feared that there will always be great danger of damage to the apparatus, and, it may be, consequent failure of signals at a time which may or may not be critical, according to the circumstances obtaining. Apparatus which will give the necessary indications to the driver without contact between the moving train and apparatus fixed upon the line are more likely to be reliable, owing to the absence of mechanical shock, but like the latter apparatus, they, as usually designed up to the present, only give their indications at certain fixed points, and leave the drivers uncertain as to the conditions when passing between those points, thus leading to doubt and consequent delay. The design of one system for such purposes, however, overcomes the difficulty, since the indications afforded to the driver are continuous during the passage of the train through the whole signalling range of each block post. This system—that of the Miller Syndicate—has recently been under trial on a Continental railway, and the trials, which will be watched with great interest, are to be continued.

It has often been objected to such systems of auxiliary signalling that they are only required to be used during a very small proportion of the working year, but that their maintenance has, necessarily, to be kept up during the whole period, owing to the uncertainty of the times when they will be required. There is no doubt but that they do of necessity involve continuous maintenance, for use during a very small fraction of the actual period of work, but if, by their means, the occurrence of such accidents as that at Cudworth and that at Slough a few years ago can be prevented, the expense to the railway companies will be justifiable. No sane person will deny that the question of expense is a most serious item for consideration in connection with such proposals, but so, indeed, is the cost of the present system—including the cost of such disasters. The whole subject, however, is deserving of being lifted to a higher plane, seeing that the destruction of human life with all its untraceable consequences, is involved.

Public Arc Lighting.

ELSEWHERE in this issue we publish an abstract of Mr. H. B. Maxwell's paper on street lighting with arc lamps, which contains much valuable information based upon the author's practical experience. His principal argument in favour of the arc was based upon its cheapness, compared with incandescent gas lamps, a virtue which, we agree with Mr. Maxwell, has been clearly proved by the frequent practical tests made by Mr. Bradley, the city engineer of Westminster, whose impartiality cannot be questioned.

Mr. Maxwell, however, in drawing up an estimate of the annual cost of an arc lamp, urges that the cost of wages at the generating station, being unaltered by the addition of street lighting, should be omitted altogether from the account. This appears to us to be a wholly unjust proceeding. Justice demands that every individual consumer shall be charged exactly in proportion to his share of the cost of production of energy, and it is certainly not fair to charge the private lighting and power consumers for the whole of the labour at the generating station.

We grant that, at the end of a year's working after the introduction of street lighting, the cost to the ordinary consumer may be found to be materially reduced in consequence of the better load factor obtained, and the attendant economies effected; but this is no justification for subsidising the arc lighting department in advance. Let the profits be made, if possible, and let the prices be equitably readjusted accordingly thereafter.

A similar objection may be applied, in passing, to the method of charging advocated by Mr. Taylor in his recent paper. In this case, again, it is not fair to impose upon the lighting consumer the whole of the capital charges relating to plant which is used for his benefit only for a few hours per day, and for the power consumer's benefit four or five times as long. The poor lighting consumer seems to be the willing horse, in the eyes of Messrs. Taylor and Maxwell, upon whom the burden shall be laid.

While we protest against the public lighting being carried on partly at the expense of the private consumer, we cannot dispute Mr. Maxwell's contention that in very many cases far too high a price is charged against the former, and we fear that in some cases this is done with a view to concealing a loss on the electricity undertaking, by thus transferring funds from one department to the other, instead of frankly calling upon the rates to make good the deficit.

Cable Tenders.

THE Cable-Makers' Association have drafted two circulars, which, they suggest, should be made use of by cable-makers when tendering for work. One relates to offers for the supply of material only, and consists of eight clauses, limiting the choice of the purchaser as regards sizes, combinations, resistances, thicknesses of dielectric lead sheathing and serving to those specified by the Engineering Standards Committee's tables, providing for arbitration in case of disputes, payment in full within one month of delivery, and maintenance for twelve months in respect of defective material and workmanship, and stating the credits to be allowed for drums detained for longer periods than three months. The other in like manner deals with tenders for the supply and laying of cables, specifying the terms of payment, the conditions of maintenance, and the issue of engineers' certificates, as well as the limitations referred to above. Uniformity in tendering is a great help in adjudicating upon the tenders, and should therefore be welcomed. The question arises, however, whether foreign tenders will be unduly benefited by the adoption of these circulars on the part of British manufacturers, the former being free to accept conditions which the latter reject. We trust that no such evil effects will be experienced.

D

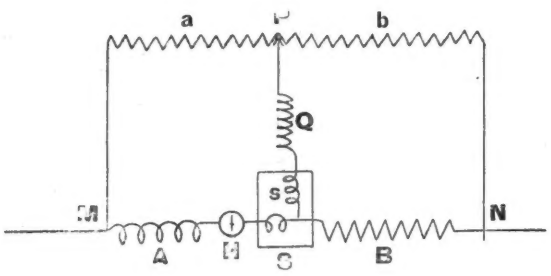
NULL WATTMETER METHODS OF MEASURING POWER.

By ALBERT CAMPBELL, B.A.

THE two interesting papers published recently by Dr. Sumpner drew attention to the fact that there was still much room for improvement in alternate current measurement. I think, therefore, that the following two novel methods of measuring power are worth considering, as they possess advantages in certain practical cases.

Method 1.—The connections are shown in fig. 1, in which A is the circuit carrying the load to be measured. In series with A are an ammeter H, the series coil S of a wattmeter, and a known non-inductive resistance B. Across the ends, M N, of the combination is put a non-inductive resistance with a contact slider P connected through a high resistance Q to the shunt coil, *s*, of the wattmeter. Since B is a known

FIG. 1.



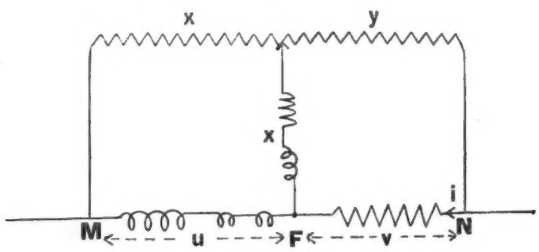


FIG. 2.

resistance, the power taken by it can be at once obtained from the ammeter reading. Now let the slider K be moved until the deflection of the wattmeter becomes zero; then

$$\frac{\text{Watts in A H S}}{\text{Watts in B}} = \frac{a}{b},$$

where a and b are the resistances of the parts into which the slider divides the branch resistance M P N.

Hence, subtracting the power lost in the ammeter and the series coil S, we can at once find the power taken by A. In the above we have assumed the resistance Q to be so high that the current through it is negligible compared with that in a or b.

The proof is as follows:—In fig. 2 let the instantaneous P.D.'s of the four branches be x, y, u and v respectively, x being the voltage across P F; let the watts in M F and F N be W and w respectively, and let i be the instantaneous value of the current in F N.

Now, $$y = \frac{b}{a+b}(x+y) = \frac{b}{a+b}(u+v).$$

The voltage, therefore, across P F

$$= x = v - \frac{b}{a+b}(u+v)$$

$$= \frac{a}{a+b}v - \frac{b}{a+b}u.$$

Hence, when the wattmeter reads zero, we have—

$$\frac{1}{T}\int_0^T i\,x\,dt = 0,$$

and therefore

$$\int_0^T i\,x\,dt = 0.$$

Thus $$\int_0^T i\left(\frac{a}{a+b}v - \frac{b}{a+b}u\right)dt = 0;$$

hence $$a\int_0^T i\,v\,dt = b\int_0^T i\,u\,dt.$$

We have therefore

$$a\,w = b\,\mathrm{W},$$

and $$\frac{\mathrm{W}}{w} = \frac{a}{b}.$$

The vector diagram of the P.D.'s for the general case (with any wave form) is shown in fig. 3, in which U, V, X and Y are the effective values of u, v, x and y respectively. In this diagram the point G does not necessarily lie in the plane L D K, except for sine curve wave forms.

FIG. 3.

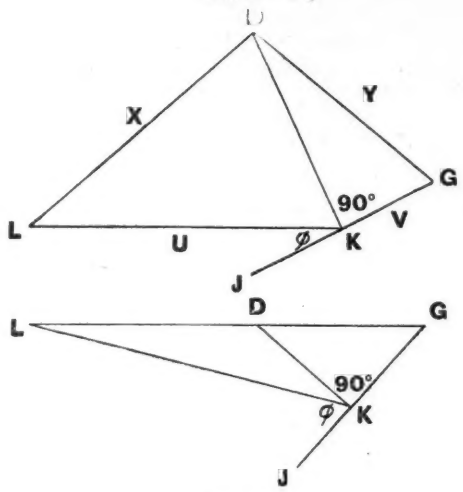


FIG. 4.

Here the angle D K G is a right angle, when the wattmeter reads zero.

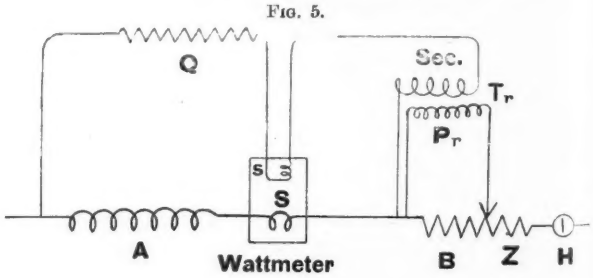
Also angle L K J = ϕ, the angle of lag between voltage and current in A H S.

With the working assumption made above (*i.e.*, current in Q negligible), the diagram becomes as shown in fig. 4, where L, D and G lie in a straight line.

In practice it would often be best to keep the resistance a (fig. 1) constant and vary b. The ammeter H, when possible, should be replaced by an electrostatic voltmeter across B.

Method 2.—Fig. 5 shows another (somewhat similar) way of obtaining a balance between known and unknown watts.

FIG. 5.



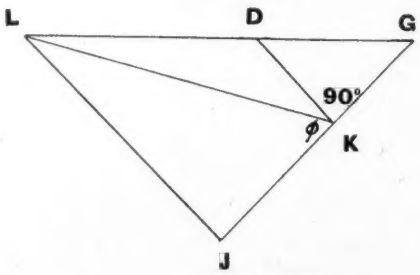


FIG. 6.

The primary of a suitable transformer T_r is put across a variable amount B of the known resistance B Z. The secondary voltage of T_r is connected, as shown, so as to be

subtracted from the voltage on A S, the resultant voltage being applied to Q *s*, the shunt circuit of a wattmeter whose series circuit carries the main current. The wattmeter reading is brought to zero by adjusting the slider on B Z. Assuming that the primary and secondary currents in the transformer are negligibly small, that the primary and secondary voltages are in practical opposition, and that the circuit Q *s* is highly non-inductive, we have—

$$\frac{\text{Watts in A S}}{\text{Watts in B}} = m,$$

where m = ratio of secondary to primary volts in the transformer.

It is easy to prove this as in Method 1, if we remember that the voltage applied to the shunt circuit Q *s* = voltage on A S − m × (voltage on B).

In connection with Method 1, Mr. Alexander Russell has kindly made the following suggestions:—"It may be objected that the deflection cannot always be reduced to zero; but this is not so, for (fig. 2) when P is near N the phase difference between the voltages on P F and F N is small, whilst when P is near M, the phase difference is nearly 180°. Hence in some intermediate position it must be 90°, and the deflection will be zero." He has also given me an alternative proof as follows:—

In fig. 6 draw L J perpendicular to G K J.

Since $\frac{1}{T}\int_0^T i\,x\,dt = 0$, the phase difference between the voltages D K and K G is 90°. Thus D K is parallel to L J.

Therefore, if I = effective value of the current i,

$$\frac{a}{b} = \frac{\text{J K}}{\text{K G}} = \frac{\text{U} \cos\phi}{\text{V}} = \frac{\text{U I} \cos\phi}{\text{V I}} = \frac{\text{W}}{w}.$$

In conclusion, I find that a null method, similar to Method 1, but using an electrometer wattmeter, has been described by Mr. Russell in his book ("Alternating Currents," Vol. I., p. 196). As the instrument there is electrostatic, the current taken by M P N can be made so small that the ammeter may be put outside the branched circuit.

SOME ANOMALIES OF MUNICIPAL TRADING.—III.

By Y. Z.

WHEN a municipality applies for authority to borrow, the Local Government Board decides the time in which the loan must be repaid. Fifteen years is usually allowed for machinery, 25 years for electric lighting plant, and a much longer term for buildings; as much as 60 years being allowed in the case of houses for the working classes. It is somewhat difficult to understand why present and prospective ratepayers should be compelled to subscribe capital to these undertakings during these widely different periods. If the works were security for the loans, it might be assumed that the life of the works was the period of the loan, and that when the whole of the capital had been subscribed the works ceased to be of value. But the works are not security, and their life is not the period of the loan. Moreover, it is only reasonable that ratepayers should expect that when the whole of the capital had been subscribed, the works should have established goodwill, and should be at least of capital value, otherwise what advantage is it to posterity to be compelled by the acts of their antecedents to subscribe.

This raises the argument so frequently used by short-sighted councillors, "that posterity had done nothing for them, so why should they do anything for posterity;" and as these men have no interest in the undertaking beyond their rates, and as they are liable to lose their office unless they do their utmost to reduce present rates, it is obviously to their advantage to let posterity "go hang."

A trading local authority may be likened unto a man who seeks to make profit by walking. He is not obliged to do this, and is not a good walker, but it is his ambition, and he therefore pawns his watch and buys boots with the proceeds. The more he walks the more his boots wear out, and the more he has to pay for having them repaired, until they become past repair. In the meantime he must pay interest and repay the loan on the watch, or he loses it. In any case he loses the use of it, and in an emergency it cannot be pledged again. Should the boots wear out before he has redeemed the watch, he loses the means of paying interest and redeeming it, unless he has walked to such advantage as to have set aside sufficient to pay for another pair of boots. Should it so happen that the boots wear out in exactly the same time in which the watch must be redeemed, and no provision has been made for new boots, he must pawn the watch again to buy another pair, that is, if he still wishes to walk. The actual case of a trading authority is far worse than this, because irresponsible persons pawn prospective watches in order to make those who follow walk, whether they like it or not. It is posterity which has to repair the boots and provide for new ones out of the profits of the unnecessary walking undertaken by its predecessors.

The question arises, How are these anomalies to be remedied? The most simple and best solution is to confine the powers of local authorities to those public works for whose execution they were constituted, but if the Government in its wisdom concedes trading powers, then let the Public Health Act be amended to regulate those powers.

Why should unwilling ratepayers be compelled to mortgage their property in order to subscribe to speculative undertakings? Surely local authorities are public trustees, and should not be permitted to speculate with borrowed money. Let those who believe in municipal trading invest their own money without compelling others to do so, and let them take *all* the profit.

Let there be a separate board of councillors elected for trading because of their special business qualifications and because of the money they have invested.

At present the accounts of a local authority are kept in the manner prescribed by the Local Government Board for unremunerative works. This is quite unsuitable for trading. It permits of favouring any pet undertaking at the expense of another. Thus a town hall may be made to pay handsomely by lettings, if the corporation is charged sufficient rent for offices. The flag-making plant of a destructor shows a good profit if its inferior productions are charged to the corporation at the price of the best. If the site of houses for the working classes costs too much to permit of the undertaking paying, the council has only to make a road improvement in the vicinity and charge sufficient thereto to make the houses pay. Instances of this system of allocation of expenditure might be multiplied many times. Councillors argue that it is not dishonest, because it is merely taking money out of one pocket and putting it into another, but the temptation to justify trading at the expense of unremunerative public works is so great, that it is essential that trading accounts should be quite separate and under the control of a separate board.

Most of the laws which govern limited companies might be made to apply to a municipality under these new conditions. It is very doubtful if willing ratepayers could be found to invest their money, or if councillors with proper qualifications would consent to sit on a trading board. In fact, if municipal trading were put on a proper business basis it would cease to exist. As it is, the more municipal trading there is the greater becomes the burden of the ratepayer. One can only conjecture what would happen in the event of a considerable number of ratepayers leaving a neighbourhood on account of heavy rates. It is to be hoped that the Government will investigate the matter fully before such a thing happens.

The effect of municipal borrowing on our industries is a matter which also calls for the immediate attention of our authorities.

Lytham Electric Lighting.—The U.D.C. has arranged with Messrs. Foote & Milne for the production and supply of electrical energy for public and private purposes, within the limits of its district, on terms of purchase in 10 or 20 years. The Lytham Electric Lighting Order was allowed to lapse last year.

VARIABLE SPEED MOTORS.

By C. L. SUMPTER.

So much has been written of late years on the subject of variable speed motors, that one is diffident of being able to say anything new or of interest on the matter.

However, the writer has found that mistaken ideas are still held by many, as to the cost and the scope of these motors, so he has ventured to try to emphasise the characteristics of what, in spite of the fact that variable speed motors were manufactured many years ago, may be called the new type of direct current motor, in its way as distinct a type as an ordinary shunt or series wound motor.

The great importance of the application of these motors with a considerable speed range to machine tool driving was first realised, to the best of the writer's knowledge, by Messrs. Vickers, Sons & Maxim, Ltd., who manufactured and applied them, with a speed range of 300 to 900 r.p.m., to a number of machine tools, as far back as seven or eight years ago.

This application has since been extensively adopted; in fact, so much importance has been attached to it, that alternative expensive and complicated three and five-wire systems and double commutator motors have been installed to obtain this speed variation.

These are, in the writer's opinion, quite unnecessary for machine shop driving. Undoubtedly, for a large number of purposes, the motor for these systems is cheaper than a simple variable speed motor giving the same speed range, but when the cost of the wiring, controllers, installing, and upkeep is

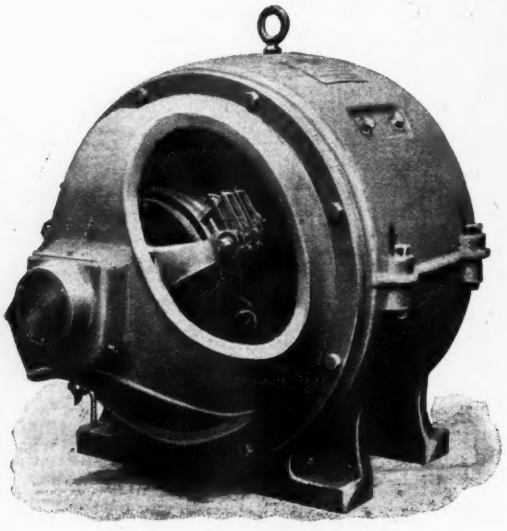


Fig. 1.—Variable Speed Motor.

taken into consideration, the total cost is greatly in favour of the simple variable speed motor.

A comparison of the output at different speeds from a given motor carcase in the cases of a double voltage winding and a single voltage winding, is given by the curves, fig. 3.

From these curves it is obvious that for machine tool driving, where the power required is practically constant at all speeds, the single voltage simple variable speed motor is no more expensive than the double voltage (the extra output at the higher speeds of the double voltage motor being of no advantage), while the single voltage motor has all the advantages of simplicity and the great saving in the cost of the controller and wiring.

The double voltage (or double commutator motor, which is very similar) will be seen to be especially suitable for driving rolling mills, &c., where the load is intermittent and heavy.

Of course a greater speed range is possible on these systems, but if the voltage of the supply is kept down below 250 volts, there is not any difficulty in designing a variable speed motor with a range of four or even six to one, which, since most machine drives are through gearing, is as great a range as should be adopted, granted that it is not economical to make motors of a slower initial speed than about 200 or 300 r.p.m.

A most interesting method of applying this type of motor for driving reciprocating machine tools, such as planing machines, was described by Mr. A. D. Williamson in his

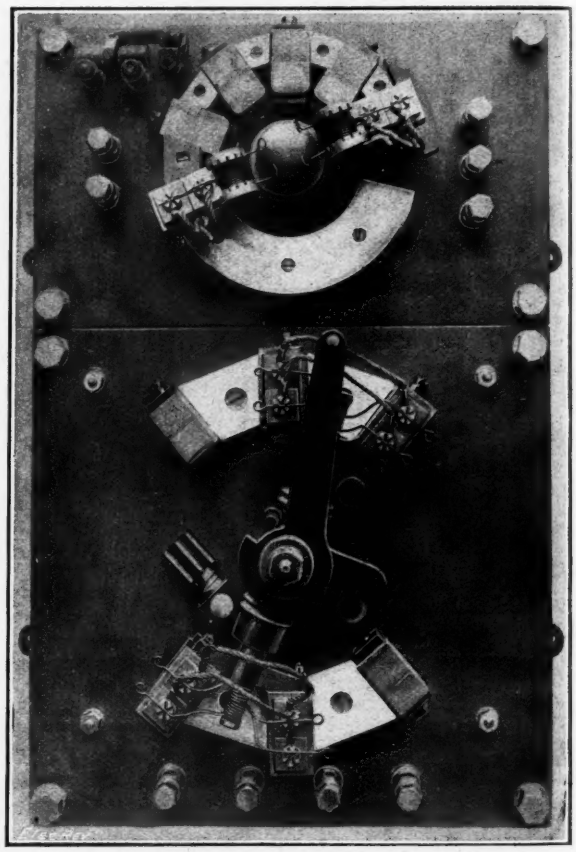


Fig. 2.—Switching Panel for Variable Speed Motor.

paper, entitled "Applications of Electricity in Engineering and Shipbuilding Works."

"A portable vertical planer or slotting machine is driven by a 5 B.H.P. motor with a range of speed from 300 to 900, the motor being attached direct to the machine. On the

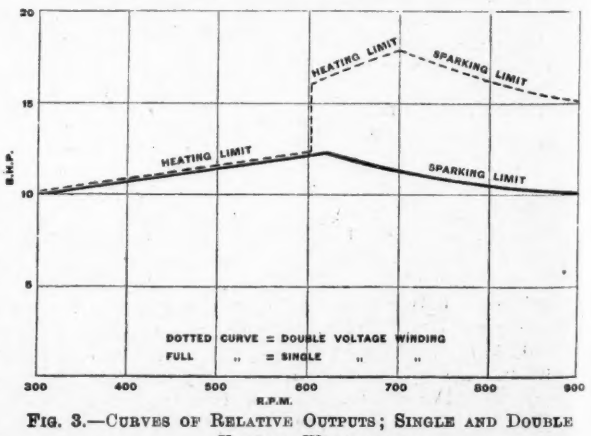


Fig. 3.—Curves of Relative Outputs; Single and Double Voltage Windings.

cutting stroke the motor runs at its slow speed, and at the end of the stroke, the length of which is easily adjusted to suit the work, the motor reverses automatically. As soon as the reversal has occurred, a resistance is automatically inserted in the field winding, quickly raising the speed to 900 for the return stroke. At the end of the quick return stroke, immediately before reversal, the field resistance is short-

circuited, providing a strong field for reversing in, and the motor reverses and makes its slow cutting stroke, the cycle repeating itself."

This method has been tried with great success on some very heavy planing machines, the motor driving the table direct through a single gear, all belts, pulleys, and almost the whole of the gearing of the machine being done away with, thus leaving very few parts to be reversed and saving a very large amount of floor space.

Where a cross-cutting motion is used, a separate motor, usually of a much smaller horse-power, is geared to it direct, the one set of switching gear controlling either as required.

The speed of reversal is dependent on the "peak" of current that one cares to allow, a rush of current of about $2\frac{1}{2}$ times the full load current giving an instantaneous reversal, while, if required, the current can be kept practically constant throughout, by reducing the speed of reversal, a very useful point if lights are supplied from the same mains.

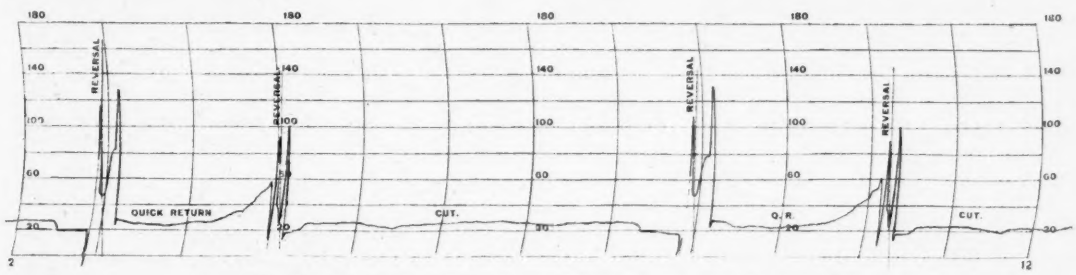


Fig. 4.—Curve of Output, 20-B.H.P. Motor Attached to Planer.

Several further points are worth drawing attention to in connection with this method, viz.:—

1. That the energy in the moving parts is expended in bringing these parts to rest at each reversal, no additional power being required for this purpose. Owing to the moving parts being reduced almost to the minimum, the efficiency approaches the maximum possible, the only loss being this kinetic energy in the armature.

2. That there is no sparking at the commutator on reversal, even when a large rush of current is allowed, owing to the slow speed, and consequently very low reactance voltage and the strong magnetic field.

3. A smaller motor is sufficient, owing to:—

(*a*) The absence of gearing, and consequent greatly reduced friction losses and fewer parts to accelerate.

(*b*) There being no shock on reversal; and

(*c*) The mean speed of the motor being high.

4. The ordinary speed variation of the cutting stroke can be used to get the maximum speed cut for different materials.

(5) Almost silent reversal.

A current curve, fig. 4, is given, of a complete cycle on a Sharp-Stewart 12 ft. 6 in. × 12 ft. 6 in. × 25 ft. planer driven by a 20-B.H.P. motor with a speed range of 300 to 900 r.p.m.; for the belt drive at the same speed a 40-B.H.P. motor was required. In this case only the belts and pulleys had been done away with, not the whole of the gearing, as is possible with this method of driving.

A photograph of the switching panel is also given (100-ampere size). Although these switches have been running a considerable time, there are no signs of wear or burning at the contacts.

Another application of the variable speed motor is for driving fans and blowers, where different pressures or varying quantities of air are required; and for pumps and air compressors, where the speed is automatically varied according to the demand.

In the two latter cases the load is approximately proportional to the speed, so that the motors, not having to do full load at the slow speed, can be comparatively small. A double voltage, or double commutator motor, would be much cheaper for this work, but the controller would be very unsuitable for automatic control.

An important characteristic of the variable speed motor is the extremely great starting torque at the slow speed, giving it all the advantages in this respect, of an ordinary series wound motor, with the additional advantage that the speed is constant under varying loads.

In this case the motor cannot be as small and cheap as the ordinary series wound crane motor designed for intermittent working, although the field winding can be run at a very high density if the high efficiency of the variable speed motor is sacrificed, making the difference in cost very small and still leaving the advantage of efficiency in favour of the variable speed motor.

An important application due to the strong torque at the slow speed and constant speed under varying loads, together with the large range of, say, 10 or 15 to 1, which the low voltage makes possible, is for gun training and elevating on battleships. The strong torque, instantaneous reversal and steady speed give great accuracy and speed.

For this work it is advisable to slightly compound the motor, so that at the highest speeds there is no danger of the motor pulling up. It is practically a series wound motor at these speeds, when the speed variation under varying loads is a distinct advantage.

Another application which is largely coming into use, is for Raworth's system of regenerative control, a system which will, no doubt, be largely applied in the future to mining and quarrying where power is expensive.

In conclusion, the writer would impress upon prospective users—

1. If a considerable number of long range variable speed motors are to be installed, to have the voltage of the supply kept low, and so avoid the use of all double voltage and double commutator machines, with their extra cost and complications.

2. When ordering these motors, to specify if they are not required to do full load at the low speed, or if they are only required to work at the low speeds intermittently, as, in these cases, the price can be very considerably reduced.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Premium System.

Many complaints and grievances of young electrical engineers have been aired through your columns during the past few months.

Now, it seems that a certain manager wants "a gentlemanly young fellow." His chief qualification, apparently, is ability to pay a premium; further, be it noted, "he is to be paid a salary according to attainments."

The arrangement strikes one as curious. First, the premium (presumably) goes to the engineer; secondly, he is to be paid a salary, depending (presumably) upon the manager's discretion. Does the manager pay this salary privately, or does it come out of the Corporation funds?

If the latter, the system seems wholly wrong, for it would be quite possible for the manager (it is not suggested that it is so in this case) to receive a "thumping" premium and return a portion thereof (out of the Corporation coffers) to the "young fellow."

The writer has known cases in which pupils have been

taken by Corporation officials at heavy premiums, and, on a vacancy occurring, these "gentlemanly young fellows" have been "jumped" into positions for which they were totally unfitted. Thus it may be said that these gentlemen have virtually bought their positions.

The whole system is wrong, and should be stopped.

Burgess.

Is Steel Conduit Wiring Doomed?

Contractors who are fortunate in the possession of intelligent wiremen and able to discriminate between an efficient system of wiring, and an inefficient one, will recognise that the conduit system is one of the best of modern times. But that it should be recommended for every class of work, irrespective of circumstances, is a question that no doubt every contractor will have his own opinion upon. Take, for instance, the wiring of a new house. The screwed conduit with draw-in boxes, and wired after plastering, makes an ideal installation, and one that will last with the building. I have never found condensation troubles in the tubes, and if iron boxes are used for the switches, the sweating from Parian cement cannot cause earth troubles.

An arrangement I have not seen mentioned, but which I have found an advantage in practice, is running the tubing under the floor joists instead of letting them in on the top and using the usual iron ceiling rose fitting.

I find a saving in fittings, greater ease in wiring, and considerably less loose floor boards, and also when a fitting requires to be altered in any way, after the house is occupied, there is not the usual moving of furniture and tussle with the carpets in the room above. The wiring of each room is complete in itself without disturbing the other parts of the house.

Now, take an old house as the subject of an installation. We have not now the facilities of erection as before, and the screwed conduit requires more labour, and is much more difficult to erect to make an efficient job.

This, in my opinion, is where the split takes place, and where we shall always have wood-casing and other systems as rivals both for efficiency and cost of erection. Again, consider an ancient church which requires lighting. I consider Diatrine lead-covered wiring in many cases is preferable to any conduit system, as offering greater facilities for concealing and erecting. In positions where damp is known to exist continually, I think lead-covered wiring has more lasting qualities than steel conduit.

As regards the slip joint conduit, probably there have been more fires caused by the indiscriminate use of this system than from any other cause, the chief fault being an earth fusing compo gas pipes and igniting the gas.

This system ought not to be used when gas pipes form an important occupier of the floor, as is the case in many business premises—even wood casing is infinitely better. In answer to the question, "Is steel conduit wiring doomed?" I consider that it will occupy a very prominent position in future work, and as contractors and wiremen learn more of it, they will feel better able to appreciate its many virtues.

Edward A. Hall.

Grimsby, *January 17th*, 1905.

Referring again to Mr. Moss's first letter, December 27th, 1904, on the above subject, he says:—"Whenever steel conduit systems are used (light gauge) and buried in wet concrete, plaster, &c., trouble will follow sooner or later."

Surely, the first thing to look to in a buried conduit installation would be to make the tubing watertight, a very simple matter, one would think, nowadays, as most steel conduits are screwed.

He also states in the same letter, "Is not it a well-known fact that in the bulk of installations, the largest number of wires possible have to go into the least number of tubes, and when the first breakdown occurs, it becomes necessary to re-wire on the surface." I again assert I have not met with these failures.

It is the usual practice, I believe, on respectable jobs, to run all the tubing first and then to draw in the wires and cables. Well, if they can be easily drawn in, cannot they be as easily drawn out for repairs?

In his second letter dated January 17th, he informs "A. M." that, as a rule, he has never got as good tests on conduit installations, even when new, as he has on casing jobs. I quite agree with him there. It is quite possible; but, taking a casing job that has been buried in wet concrete or plaster, say, after six months' use, how will it compare then with a steel conduit job properly installed?

With regard to the exorbitant cost Mr. Moss mentions, surely the trade union rate of wages is reasonable enough, and most corporations and companies enforce it as well as the recognised hours of work.

Finally, I would ask Mr. Moss what form of protection he advocates for wires that are to be buried in wet concrete, plaster, &c., to say nothing of work exposed to the somewhat uncertain weather of our English climate.

E. R. Mahood.

Brighton, *January 24th*, 1905.

I have followed, with interest, the views of your correspondents on the above subject, and it seems that, leaving out the statements made by such ardent disciples of steel conduit as Messrs. Mahood and Edwards, there is little doubt that steel conduit possesses many grave defects. The writer has installed many miles of conduit, and has no doubt that steel conduit is not a permanent wiring system, but is bound to be superseded sooner or later by something more satisfactory. Given a reasonably heavy gauge, the defects of steel conduit are not so much mechanical as electrical, though by far the largest amount of conduit used is light steel tubing, either with the fishing-rod type of joint, or some of the new pattern joints, which have just been introduced.

These thin conduits have reduced interior wiring to the level of a burlesque, for who, but anyone wishing to perpetrate a huge joke, would ever assert that these light tubes are any sort of protection at all. They certainly will not resist a well-driven nail, and after having been buried in plaster for about three years, there is nothing left but a streak of rust around two or more wires, the insulation on which has deteriorated until it is of the most precarious nature, liable to cause a flare up any time it is disturbed by an enterprising mouse. The people who erect this sort of conduit call themselves electrical engineers!

Steel conduit with a paper lining such as has been suggested by your correspondent "A. M." is undoubtedly good, I have used it occasionally, but in order to have the same internal diameter, one must use a larger size of conduit (outside diameter), and few people will pay the extra cost. Moreover, borough engineers will not encourage it, because it tends to raise the cost of wiring, and so make electric light installations more costly, and discourage prospective consumers; but it appears that we are not without a remedy: Those of your readers who are members of the Institution will remember that, during the discussion on the Institution visit to Germany, one of the members mentioned that he had visited the conduit works of the Bergmann Electrical Co., and there saw the manufacture of bituminous tubing with a brass armouring. This consists of a conduit resembling a paper tube, but rather different in some respects, armoured with a covering of sheet brass; such a tubing is superior mechanically to the light gauge steel tube, to which I have already referred. Moreover, the brass will stand the acids in plaster and cement infinitely better than steel; even did the brass disappear in course of time, a stronger tube still remains, made of a material which is chemically stable, unaffected by water, of high specific insulation, and, unlike steel tubing, does not contribute to the destruction of the insulation on the wires, owing to internal condensation.

With regard to this latter point, steel conduit makers always insist that internal condensation is a bit of a bogey, which is frequently used to frighten people out of the habit of using steel conduit, but I notice that in a book recently issued by one of the leading conduit manufacturers interesting sketches of how to arrange the tubing to get rid of water which flows down the pipe, are shown.

Apart from all this, the tubing can be jointed in a much more satisfactory manner than the steel tubing, because the joints can be made water-tight, such brass armoured tubing will not burn, and for interior wiring at 250 volts seems to

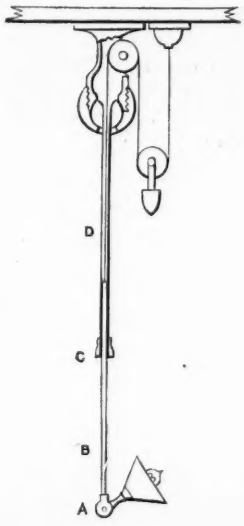
be undoubtedly superior to any kind of steel conduit, moreover, it is cheaper, and, therefore, is a step in the direction of every electrical engineer's ideal, viz., how to wire a building at a price comparable with gas piping. I have seen huge wiring jobs carried out with this tubing on the Continent, and my American friends assure me that it is equally popular on the other side of the little Fish Pond, which our Yankee cousins so frequently cross.

If this system of wiring is so satisfactory in these countries, what is the objection to it here? Cannot our fire insurance friends, and even the manufacturers of steel conduit, tell us through the medium of your columns what are the defects of this tubing?

Electra.

Glow Lamp Pendulum.

Regarding the illustrations of an improved workshop fitting in the last issue of ELECTRICAL REVIEW, I made and fitted a number of these fittings some seven years ago when engineer to the Webly Scott Arms Co., of Birmingham, and



A is a flat section swivel joint allowing lamp to be swung or turned up nearly vertical, so as to have the light under work in a vice. A is screwed on to a straight piece of $\frac{3}{8}$ in. brass tube, B. This tube, B, slides through stuffing box, C, into tube D, which is screwed into a ball joint fitting. This fitting is slotted on one side, and provided with a pulley. The wire workshop flex is taken from ceiling rose to counterweight, and then over pulley, through ball joint and down tubes D and B.

believe they are still in use, the only difference was that these had better adjustments than the German fittings. I enclose rough sketch.

B. Barber.

Oulton Broad, *January 17th*, 1905.

Batteries with Reversible Boosters.

Accumulators play an important part in the working of nearly all continuous current and some alternating current installations, and are even used to a greater extent in the United States of America than at home. They labour under two great disadvantages, viz., their initial cost being high and their life short, which help to destroy the economy they effect in many other ways. The favourable opinions expressed by many engineers for reversible boosters, while helping to emphasise the disadvantages of accumulators, lead one to believe that these boosters "fulfil a long-felt want." So far no articles have appeared in the ELECTRICAL REVIEW dealing with them, so if you intimated that contributions from those who have had actual experience with them would meet with editorial favour, such articles would, without doubt, be read with much interest by a large majority of your readers.

In a paper on reversible boosters by Mr. C. Turnbull, read lately at the Newcastle Local Section of the Institution of Electrical Engineers, it is stated that batteries adapted for working with reversible boosters "can be made and maintained at about half the ordinary price. . . ." Some further particulars of such a cell would be welcome, especially at present, as the number of gas-driven installations is rapidly increasing. In the United Kingdom there are now 28 gas-driven central stations, and in them accumulators are necessary to a greater extent than in steam-driven ones owing to the difficulty in governing gas engines, and to their not lending themselves to being temporarily overloaded to the same extent as steam engines do.

Assistant.

[Several articles on reversible boosters have appeared in the ELECTRICAL REVIEW.—EDS. E.R.]

Nernst Lamps.

I hope the practice of raising the voltage 10 or 15 per cent. above the nominal in the evenings and returning to the nominal or below during the day is a temporary expedient only. Fairly uniform voltage is generally implied, and forms part of the purchase made by the consumer unless he contracts himself out of it. His fittings and lamps are adapted to the nominal voltage, and one result of the increased voltage above mentioned is that the consumer's bill expands perhaps proportionally, and more than proportionally where a watt-hour-meter is used, and his lamps frequently break down, especially before and after the peak. The supply company not only profit by the increased output, but save the capital which would otherwise be sunk in the alterations necessary for the same output at nominal voltage. It is doubtful whether this is true economy, as the consumer becomes dissatisfied at the really unnecessary addition to the cost of his lighting. It is my sincere wish that circumstances and closer supervision will lead to reasonable variation limits, whatever may be the maximum, for the benefit of all parties.

R. Pippette.

London, S.W., *January 23rd*, 1905.

In summing up the various opinions expressed by your correspondents in response to my queries, when I first brought this subject before them by your kind permission, it would seem to me that the trouble experienced with the Nernst lamp is fairly distributed.

A. C. Hanson emphasises the importance of steady voltage, and, though he has obtained good results with $\frac{1}{2}$-ampere A type, condemns the $\frac{1}{4}$-ampere U-type filaments as being far from satisfactory.

"S. W. R." suggests that the *maximum* voltage should be ascertained before lamps are put on the circuit. Will any corporation or company engineer admit more than $2\frac{1}{2}$ per cent. above or below the declared pressure? One at a time, please!

"Amused," "S. W. W.," and R. Pippette refer to the variation of public supply pressures as the probable cause of the troubles.

H. Willoughby Lance sent an interesting letter, and I like his suggestions. He confirms the inferior results with $\frac{1}{4}$-ampere U-type filaments. His life records, however, are of little value unless the *hours' use* of the lamps is also given.

I agree with "Diavolo" that the light is better with the B-type U filament, as the heating coil can make no shadow marks on the globe. He has indeed been fortunate with his results.

"Suburban Contractor" confirms the remarks of Henry Joseph. The renewals he refers to as being much more in November than in four summer months is not surprising, it is the hours' use that must be taken into account, and in November the lighting hours are many.

From Drake & Gorham, Ltd., we get a statement, but not much help. I think a firm of their repute might have given the advantage of their experience with "the component parts" for the benefit of electrical people, if not to get the Nernst in better favour.

"R. A. P." and Henry Joseph refer to the U-type $\frac{1}{4}$-amp. burner as "a fatal mistake," and their experiences follow mine very closely. "R. A. P." refers to a tendency for the filament to short circuit on the heating coil when "the lamps do not hang vertically." I have had many burners fail in this way after a few hours' use, but with lamps in a vertical position, and I do not think it is caused by the

lamp being inclined. I note he says, "polarity can be ignored," with a proviso, and I cannot see why it should not. Have the makers ever given a reason for the theory that polarity must be observed?

"Nehpets" appears to have met with success only with the ½-amp. A type burners, and that with 270-volt lamps on 250-volt circuit.

In conclusion, I would say that I think contractors have much reason to complain of the treatment meted out by some of the wholesale agents for Nernst lamps, as it is little use to try to obtain redress from them. I wrote to one of the principal firms amongst them, stating circuit voltage, and the burner and resistance I was using, and complaining of the early failure of filaments.

They did not say the combination was right or wrong, and offered no advice, but said if the lamps were used properly, they could not fail to give satisfaction.

I believe the voltage of supply is more regular here than at many places, the declared pressure being 220 volts, continuous current, and in my opinion Nernst lamps should give better local results than we get now.

I trust the perfecting of the present Nernst burners will be taken in hand, and, given reliability, the economy of the lamp will be really worth having.

Gloucester.

I should like to give a few details concerning my experience of Nernst lamps. I purchased five 36-c.p. lamps in November, 1903, which have been in constant use in a small shop ever since, along with a few of the ordinary 16-c.p. incandescent type.

First in regard to the variation of pressure damaging the lamps. In my case the variation of pressure is very considerable, as we are situated at the extreme end of a low tension network, and practically the whole of the evening at intervals the light varies very considerably. But up to the present the ill effects of such variation have not been very manifest, only one resistance so far having burnt out.

The burners have in all cases, with one exception, lasted 400 hours, the exception being 16 hours.

I find that the older the burner the more time it takes for the filament to glow, and in respect of the new curved type of filament, I find that it takes considerably longer for the filament to glow, even when the burner is new, than the old type of straight filament.

To sum up, I have come to the conclusion that the premises are much better lighted, for the same cost as previous to getting the lamps.

Student I.E.E.

The Finsen-Reyn Lamp.

In your issue of the 20th inst. you published an article describing the "Electrical Equipment of a London Hospital," by Messrs. Lemmon & Co.

It is only right that your readers who may be interested in the question should be warned that the Finsen-Reyn lamp there illustrated and described is not a true Finsen-Reyn lamp, but an imperfect copy of it of German make. The name has been usurped, and I understand that a larger sum is being charged for the copy than the original lamp costs.

My friend, Dr. Reyn, showed me his lamp when he was elaborating it in conjunction with his brother-in-law, the late Prof. Finsen, at the Copenhagen Institute, and I first introduced it into this country, publishing a description of it in the *Lancet*, in February, 1903.

The real lamp is made by Jul. Warburg, of Copenhagen, and has stamped on the telescope the names of the maker and "Niels R. Finsen."

It is not generally known that with each one issued is sent a certificate signed by two doctors of the Finsen Institute in Copenhagen, showing that the lamp has been properly tested and passed at the Institute. As a matter of self-protection, Messrs. Lemmon & Co. should be asked to produce this certificate with every lamp that they supply as a Finsen-Reyn.

Geo. H. Graham, M.D.

London, *January 23rd*, 1905.

The Effect of Ozone on Insulation.

During the many years' experience I have had with the generation and distribution of 10,000 volts, I have found that whenever ozone is given off to any large extent round the insulation of coils or apparatus carrying high-tension current, one must expect a breakdown of the insulation sooner or later. I have had great difficulty in getting over this trouble, and consider it is one that should be carefully looked for, especially in the general design of certain alternators and transformers.

Now that there are so many stations in this country, besides Deptford, where extra high pressures are dealt with, I shall be greatly interested to hear if other engineers have had the same trouble, and what steps they have taken to prevent its recurrence.

G. W. Partridge.

London, S.W., *January 24th*, 1905.

The Registration and Remuneration of Wiremen.

I am sure that all workmen who follow their trade intelligently and thoroughly will appreciate the splendid service that Mr. Frank Suter is rendering to the working part of the electrical industry. His efforts, I am sure, will meet with the success he richly deserves. I have not the pleasure of knowing him, but I heartily thank him on behalf of my fellow workmen.

Short Circuit.

In your "Correspondence" columns there has been some articles on wiremen. I wish to draw your readers' attention to their remuneration as against that of other trades. Take, for instance, wiremen, joiners, bricklayers and plasterers. The Manchester rates are as follows:—Wiremen, 8½d. per hour; joiners, 9½d. per hour; bricklayers, 10d. per hour; plasterers, 10d. per hour.

What comparison is there between a bricklayer and a wireman? A bricklayer has no "appearances" to keep up, he has the one thing to do year in and year out; a wireman never has done learning. One week on casing, the next on conduit, the next on telephones, the next on motors, and so on. Also he has to use great care in drawing in his wires and fixing his fittings; as every contractor knows, the slightest carelessness on one man's part is a complete absence of a good test.

As a wireman myself, I have often thought it would pay contractors to give a bonus on each "megohm," and it would encourage careful work.

Mr. Godwin seems to have had difficulty in getting hold of intelligent charge-hands. There are plenty to be got who could be left to plan out his jobs for him and save his valuable time and "brains," although I will admit that the market is well over-run with "jerry wiremen" who do no good either to themselves or the other members of the same trade.

H. A. Leggatt.

Manchester, *January 23rd*, 1905.

I have read the interesting letters each week *re* wiremen and wiring contractors, being one of the old school of 25 years' experience, commencing as a telegraph engineer, for 10 years in the Government employ, where I had at different times the control of a large number of men, and for this past 14½ years a contractor. I have had during this time all sorts and conditions of both work and men through my hands, therefore I trust the few remarks I make will be understood as gained from my own personal experience, spreading over a great number of years. I have had the opportunity of watching the development of the trade to its present stage, the various prices obtained for work in the old days, and the present cutting prices.

I am inclined to think that most of the remarks made by Mr. Godwin are substantially true, although some of the qualifications asked for by Mr. Suter should be insisted on, viz., carefulness, attention to detail, mechanical skill. I quite agree that the greater part of the wireman's work is buried, and I am afraid if Mr. Suter had had the same trouble as I have had with some of

their work he would wish some of the wiremen buried with it. In my own opinion, there is not one good wireman in a dozen. I have employed men, even through the advertising column of your own paper, giving them the highest wages, and most of them could not be trusted to do a job properly. I don't think this state of things is so bad in other trades.

Now, as regards the contractor. I live in a town where there are about 20 of us; quite 15 of these are composed of ironmongers, builders, plumbers, gasfitters, one is a retired draper, one a grocer and one a carpenter. These are the class of men I meet in nearly every case where I have to tender for jobs, and who are in most cases responsible, coupled with bad workmanship, for the disgraceful work that is being carried out in some parts of the country, and to a great extent for the unfair competition, by rushing into a trade they do not understand more than setting a few fittings or pricing a job from a book. A society that would help to raise the standard and quality of both masters and men would be rendering a great service to the trade generally.

A.M.I.E.E.

What a fallacy it is to think that by registering a wireman as competent, good work can be obtained from him. Would plumbing or sanitary work be kept up to its present standard if it were only left to the registered workman? I say emphatically *no*! It is the system of supervision exercised over him by the water companies or Corporations and sanitary authorities that prevents shoddy work. Either the fire insurance companies or the supply authority should exercise the same supervision over wiring, *i.e.*, no work or joints should be covered until inspected and passed.

The tendency to dry-joint (if I may coin a word) is on the increase, lads learn it from the men they work with, tube work is run the nearest way whether best or not, tees and fittings being left out wherever possible, wires are left under floors, whose only protection is their insulation. In fact, as I understand wiring work in this town, the man who can get through the largest quantity in the shortest time is the best man.

I have known men who are trusted up to the hilt by firms of some standing here, repeatedly do work as described by myself. Would registration cure them, think you? No—it is not the want of knowledge, but the lack of supervision that causes it.

The registration of workmen by the Manchester Branch E.C.A., scents too much of the secret character note, and no doubt will lead to much injustice. Firms who have some grievance against a workman, trivial though it be, will prevent that man, however competent, from obtaining work. This is largely so, I believe, in the boot and shoe trade, from which I could quote several instances.

The letter signed by Edwin H. Godwin reads as though he never saw a competent wireman. Perhaps some firm has a good specimen it could lend him to look at, one that can do joinery work like a carpenter, lead and iron pipe work like a plumber, and who will work for a 20 per cent. less wage than either of the aforementioned trades.

Apologising for trespassing so far on your valuable space, and enclosing my card, I subscribe myself

Albert B. Butt.

Leicester, *January 23rd*, 1905.

Tabloid Electricity.

Your correspondent "Greenhorn's" suggestion is ingenious and amusing. Has he never heard of "free wiring," which is a method adopted by supply authorities to overcome the difficulty he indicates? We shall be glad to supply him with any information on this subject that he desires if he will communicate with us.

R. J. Nicholson & Co.

Manchester, *January 20th*, 1905.

Fault Localising Instruments.

Our attention has been drawn to an article on "Fault Localising Instruments" in your issue of December 23rd last.

We would point out that the arrangement described by your contributor was published in the *Journal Télégraphique* by Prof. Tobler, and in the *Physikalischen Zeitschrift* by Dr. Bruger in 1902. Our instruments for the Varley loop tests have always been arranged in this manner.

Union Electric Co., Ltd.,
H. G. MUBS, *Technical Manager.*

London, E.C., *January 23rd*, 1905.

The Dignity of the Profession.

As the involuntary cause of the correspondence under the above heading, and as some of your correspondents have scarcely got the correct version of my resignation, I would claim your permission to state, as briefly as possible, the true reasons.

The Council in question, without any advice, or even consultation with me, passed a resolution that the assistant engineer was to send in his resignation, and that the jointer was to help in running the plant, and at the same time do all outside work that was necessary. Now, as the staff only consisted of one stoker, one jointer, an assistant and myself, to be deprived of my principal assistant, in face of the heaviest load of the year (December), and to have in his place a jointer, was more than I could stand. I wrote to the Committee, asking them to rescind the resolution, which they, in their wisdom or parsimoniousness, declined to do, in consequence of which I immediately sent in my resignation.

If there is any credit attached to taking such a step to support the "Dignity of the Profession," I should like some of the credit also to fall upon the jointer, who has been with me in three stations that I have been connected with, and who, on being approached by some of the Council on the above subject, let them know that they had got hold of the wrong man in this case, as he indignantly declined to take his "master's job." He gave notice, and within a week was quickly snapped up by a brother engineer.

I agree with "Turbo" and "Two Central Station Engineers," that in order to uphold the "Dignity of the Profession," it would be more to the point if, instead of quibbling whether "Jack is as good as his master" (with all due respect to those who are the constituted authorities over us) they would devote some of their energy to protect the "profession" from that class of councillors who are so apt to imagine that their position not only qualifies them, but compels them, to interfere in matters of which they know nothing, or (worse than nothing) a little.

Cyril R. Heron.

Huddersfield, *January 23rd*, 1905.

In reply to "Latitude," I can positively assure him that I did read and re-read the letter from "Impudence," and the more I read it the more puzzled I became as to its real meaning, but eventually thought I could trace its meaning and replied accordingly. I can, however, sincerely assure "Latitude" that I wrote quite free from bias, it seeming to me to be a correct interpretation of a very ludicrous letter. In the course of my career I have at times held the destiny of some of our rising generation in my hands, and considered that a trust of national importance. I have always endeavoured to extend a helping hand wherever possible to those who needed it, and have felt a pleasure in knowing that I have contributed something towards the elevation of someone who perhaps was not quite sure of his course, insisting always upon justice and fairplay between employer and employed, and it is because of this that I feel compelled to ridicule anyone who cannot call a spade by its proper name. It is very essential that we should know exactly where we are in these matters.

I still maintain that if the jointer in question was a jointer, then by taking an assistant engineer's appointment, he did not climb the ladder that "Impudence" thought he had, but he slipped off the particular round he was on; but if he was a jobber, then in all probability he did climb the ladder called "monetary consideration," and perhaps to the

detriment of some poor young engineer who had spent his time and money at engineering, and not at jointing. This shifting from pillar to post cannot remind one of anything other than unskilled labour, and it tends to produce it, because the foundation is not right.

A central station is not the place to start a technical institute, or a philanthropic society. In these days, when much money of the people has been, and is being, spent in municipal and other enterprise, and engineers are having to deal with committees of a very doubtful and hybrid character, it will not add to their better understanding of the proper mode of procedure by letting them know that "I have been able to effect an alleged economy by taking so and so out of one job, and putting him into another." We undoubtedly want the best men in the best places, and in their proper places, that is the best economy; we want the energetic to receive their reward for their energy, and as the general tendency of events for many years past now is (due to the vast amount there is to become expert in, in each branch of the profession) to specialise, then let us aim at absolute proficiency in whatever branch we find ourselves attached to. We shall then know how to train our youth, and so put him into possession of the knowledge and experience that he will require in advancing years, instead of letting him seek out in advancing years the guidance he required in his youth.

The prevalence of all this dog-and-the-shadow kind of business is due to the neglect of our youth in the last decade or so. He has found a job somewhere when he has started out to work, and has drifted here and there, according as the waves of circumstance have taken him, and subject to the indifference his employer has bestowed upon him, simply using him as a part of the mechanism of his enterprise, instead of considering that the ultimate result of these proceedings would be a crop of vacillating know-nothings, grasping at any straw that floats by on the tide.

A Deep Thinker.

LEGAL.

Sumner *v.* Sumner & Clementson.

At the Chancery Court, Liverpool, on 11th inst., Mr. Roby applied for an order on Mr. West, the receiver appointed in this debenture-holders' action, to deliver over to Messrs. Veritys, Manchester, electric appliances which were sent to Messrs. W. E. Sumner & Co., Liverpool, on approval. It was explained that W. E. Sumner & Co. was merged in the firm of Sumner and Clementson. The receiver had not got possession of all the goods given to W. E. Sumner & Co. on approval, but admitted having part of them.

Mr. Lawrence, who appeared for the company, said that the moment the goods passed out of the control of the firm into that of the company the property in them was vested in the company, and they formed part of the security of the debenture-holders. The applicants must claim as creditors.

His Honour found that no contract of sale had been ratified, and made an order for the delivery up of the goods in the receiver's possession.—*Manchester Guardian.*

Elven *v.* The Great Northern and City Railway Co.

This case came before Mr. Justice Warrington, sitting as an additional judge of the King's Bench Division on 19th inst. It was an action by the plaintiff to enforce a verdict of a jury, and to recover from the defendants £540, together with interest at 4 per cent.

It appeared that the plaintiff was a leaseholder of 52 and 54, City Road, holding a 63 years' lease from December, 1874. He occupied the premises as a coffee-house keeper. The defendants were constructing a tube railway near the premises, and the complaint was that the premises would be seriously affected by structural damage. The matter came before an under-sheriff and special jury on March 21st and 28th, and the jury awarded the plaintiff £540.

Defendants resisted payment on the ground that the plaintiff could not recover any sum beyond that contained in his original notice of claim, and they alleged that the £540 awarded by the jury included extra items, which were freshly introduced after the formal notice of claim and sealed offer had been made. Defendants also said that the amount included a sum for underpinning.

Mr. Cripps, K.C., and Mr. Dott appeared for the plaintiff; Mr. McCall, K.C., and Mr. Neilson for the defendant.

At the conclusion of the argument, his Lordship gave judgement for the plaintiff for the amount claimed and the costs of the action.

Traveller's Action for Wrongful Dismissal.

In the Lord Mayor's Court on January 20th, before Sir Forrest Fulton, K.C. (the Recorder), and a jury, Mr. A. E. Catchpole, traveller in the electric fitting business, sued the Champion Baby Arc Lamp Co., 16, Farringdon Avenue, E.C., for damages for wrongful dismissal and breach of contract to employ him for the sale of the Champion Baby arc lamps. Mr. D. McGarel Hogg was counsel for the plaintiff, and Mr. E. F. Lever for the defendants.

The plaintiff, a commercial traveller, became acquainted with the defendant company, which consisted of Mr. Moffat and Mr. Bowyer, in consequence of an advertisement in the *Daily Telegraph*. In the beginning of October he called at the place of business of the defendant company, and there saw Mr. Bowyer, who said they had a patent electric lamp they wanted to push the sale of. It was considered to be an improvement upon anything in the market, and was an intermediate lamp between the incandescent and the arc lamp. The plaintiff was told that he could only be employed temporarily until the return of Mr. Moffat, who was in the United States, but was then suffering from the effects of a motor-car accident. On October 11th a letter was written, which the plaintiff relied upon as the contract in the case. The terms of his remuneration were to be 2s. 6d., 6s. 6d., and 13s. 9d. per lamp, according to the class of business he introduced. The plaintiff travelled for a fortnight, and was successful in placing the defendant company's lamp before several large firms, some of which gave orders for sample lamps. On October 25th he called at the defendant company's office with an order from Messrs. Rawlings, and after it had been accepted, was told that his services were no longer required. The reason given was that the electric lamp required improvements made upon it, and while this was being done the article would be removed from the market.

The plaintiff, in his evidence, said that he had been shown a pictorial advertisement of the electric lamp which the defendants were going to sell. As a salesman of electric fittings, he thought the lamp, as described, would be an article for which there would be a ready sale. As a result of his services, he had induced several large firms to give trial orders for the lamp, amongst them being the Army and Navy Stores and Spiers & Pond, Ltd. Subsequently he was told by Mr. Bowyer that the lamp was not giving satisfaction, and that they (defendants) were going to discontinue the sale of it. At that time he drew his (plaintiff's) attention to a lamp which was burning, and which gave a flickering light. He (defendant) said something about the patent being improved. He told the defendant that he should require them to recompense him over the matter. From the first he had been very much impressed with the lamp, and he considered he would have been able to sell at least an average of two dozen a week. The lamps were intended for interior lighting. Taking the sale of such a number of lamps at the medium percentage he was to receive (6s. 6d.), he would have made about £8 a week.

Mr. Bowyer, one of the defendants, said the defendant company carried on business at 16, Farringdon Avenue. Their business was to buy electric lamps on the Continent and to sell them in this country. He had a pictorial advertisement of the electric lamp which the defendants were going to take up, and which was manufactured in Berlin, and he believed the statements contained in it were correct. But of 48 lamps which had been sent out, practically the whole were returned. Having regard to the complaints made, it would not have been possible to have continued the supply of the lamps. It was owing to the discovery of a latent defect in the lamp, which he himself had made, that the sale of it was withdrawn. Tests were made with the lamps, and the engineer from the Berlin firm was sent over to inquire into the matter. The plaintiff had not sold any lamps, and one which was supplied on approbation was returned. He had done what he thought was the straightforward thing in the matter, and explained to the plaintiff why the lamp would have to be withdrawn from sale. He (plaintiff) had been informed that as soon as the lamp was perfected, arrangements would continue as before. Mr. Moffat, who had recovered from the effects of the motor-car accident, had not returned to this country yet.

The Recorder, in summing up, said the case was not free from legal difficulty. The conclusion he had come to was that there had been a breach of the contract entered into between plaintiff and defendant. By the contract it was contemplated that the plaintiff, as traveller, should receive from time to time as he required, such lamps as his customers ordered. Through a latent defect the defendants were obliged to withdraw the sale of the lamp. This happened after the plaintiff had been employed for two weeks receiving 60s. a week. The question for them (the jury) was, what damages, in their opinion, was the plaintiff entitled to, if any. The amount the plaintiff was entitled to was a purely hypothetical question, and there was really nothing to guide them. The arrangement for the plaintiff's employment was only to last until the return of Mr. Moffat, but, as they had heard, that gentleman had not yet returned to this country.

The jury returned a verdict for the plaintiff, and awarded him £10 damages. Leave to appeal was given, a stay of execution being granted for 14 days.

Edey *v.* Smith.

In the City of London Court, on 20th inst., before his Honour Judge Rentoul, K.C., the last stage in this case, which has been partially reported in these columns, was reached. The action was brought by Mr. F. G. Edey, trading as F. G. Edey & Co., electrical engineers, 29, Ludgate Hill, E.C., against Mr. F. H. Smith, trading as Smith & Co., of Beaufort Street, King's Road, Chelsea, for £75

for work done and materials supplied for electric lighting at certain flats. When the case was last before the Court, Judge Rentoul, K.C., gave judgement for the plaintiff for £20 on one item of the claim, and said that as to the rest the plaintiff was to complete the work. It was now stated that the defendant would not allow the plaintiff to do so, and judgement passed for the plaintiff for £46 5s. in addition, and costs.

ELECTRIC TRAMWAYS CONSTRUCTION AND MAINTENANCE CO., LTD.

IN the Chancery Division on Tuesday, the petition of Mr. A. J. Paine to compulsorily wind up this company, was down for hearing before Mr. Justice Buckley.

Mr. NORTON, K.C., stated that the petition had stood over formerly until after the hearing of the criminal proceedings at the Old Bailey. There was another action which had been fixed for the middle of February, and it was now suggested that this petition should stand over. The action was to try the question whether or not the plaintiff was entitled to his shares.

The petition was ordered to stand over accordingly.

A summons "to stay proceedings" was also directed to stand over.

HARTER *v.* MANCHESTER CORPORATION.

THIS vibration case was mentioned at the Chancery Court in Manchester on 16th inst. Mr. Grant said it would in the ordinary course have come on for trial in the witness actions, but terms were being arranged, and he asked that it should stand over generally.

Mr. MABERLY, for the Corporation, assented, and the Vice-Chancellor (Sir Samuel Hall) directed accordingly.

His HONOUR remarked that there was another case, Barlow *v.* the Corporation, but Mr. Maberly intimated that that was not settled.

Mr. GRANT observed that it first came on in 1903, stood over till 1904, and was afterwards again adjourned for a year. In the ordinary course it would come on for trial; at present there was no suggestion of any application.—*Manchester Evening Chronicle.*

FORWARD ENGINEERING CO. *v.* BANBRIDGE FOUNDRY CO.

ON 20th inst., in the King's Bench Division, Dublin, in this case, Mr. W. M. WHITAKER, on behalf of defendants, who carry on business in Newry and near Banbridge, applied for an order of discovery of documents. The original action was brought to recover £138, the price of an oil engine, which the defendants purchased for the purpose of erecting an electric installation at Lord Kilmorey's, Mourne Park. The defendants brought the money into Court, and it was accepted by plaintiffs, but the defendants counter-claimed to recover damages for breach of contract in connection with the engine, and for delay in delivery of it.

Mr. COLLINS, for the plaintiff, asked for a cross order, and the Court granted both applications.

HOLDERN AND ANOTHER *v.* ANTI-VIBRATOR, LTD.

MR. JUSTICE WARRINGTON, on Wednesday, had before him this action in which the plaintiffs, trading as the Max Electric Accumulator Co., originally claimed £210 for three batteries, with cases. A receiver had been appointed for the defendant company, and they did not appear, and plaintiffs only proceeded in respect of one battery, which had been actually supplied.

Judgement for the plaintiffs for £66 and costs.

BRUCE PEEBLES & CO. *v.* HESTER.

THIS case came before the Court of Appeal, composed of the Master of the Rolls and Lord Justice Cozens-Hardy, on Monday, on the appeal of the defendant from an order of Mr. Justice Jelf in chambers.

It appeared that the plaintiffs, a firm of electrical engineers and contractors, of Edinburgh, brought an action to recover from the defendant £3,630 as acceptance of two bills of exchange dated June 3rd, 1904, which bills upon presentation were dishonoured. It seemed that the defendant owned an estate on Canvey Island, upon which he wished to have a tramway built, and he entered into a contract with the defendants to do the work. The tramway was to have been completed by June last year, but it was not, and it was agreed that a penalty of £1,000 should be paid. Afterwards an arrangement was entered into under which the Bills, the subject of the present action, were given. They were given in respect of moneys admittedly due from the defendant to the plaintiffs in respect of the work, but the defendant contended that it was a condition precedent to the bills being presented that the plaintiffs' contract should be completed by September 3rd, 1904. Defendant alleged that the contract had not been completed up to the present, and that he had therefore a good defence to the action. Mr. Justice Jelf in Chambers gave the defendant leave to defend the action on bringing £1,000 into Court. Defendant appealed on the ground that he ought to have unconditional leave to defend.

In the result the appeal was allowed, the costs of the appeal being made costs in the case.

BUSINESS NOTES.

Catalogues, Lists, &c. — HERR HERMANN LAX, Kopenicker Str. 121A, Berlin, G.O., has sent us illustrated trade sheets of his small electrical novelties, &c.

From the ELECTRICAL CO., LTD., 121, Charing Cross Road, we have received their price lists of slow-speed D.C. dynamos and motors, and the latest Nernst lamp card.

A batch of leaflets has come to hand from MESSRS. SIEMENS BROS. & CO., LTD., York Street, Westminster, S.W., relating to their large "H type" generators, and also diagrams of connections of motor-starters, shunt and compound generators and motors.

MESSRS. EDWARD LE BAS & CO., Dock House, Billiter Street, E.C., have sent us a malleable tube fitting list of the Geo. Fischer Steel and Iron Works, Ltd., of Schaffhausen, Switzerland, and Singen, Germany, for whom they act as sole agents for Great Britain and the Colonies. The firm have over 3,000 varieties of special fittings, many of which are illustrated and priced in the list.

The GENERAL ELECTRIC CO., LTD., 71, Queen Victoria Street, E.C., have issued a list describing their "Stanley Edgewise" circuit-breakers, Angold automatic suspension gear and contact device, suitable for any make of lamp, electrical fittings, and special water-tight alarm bells, and a key designed to meet mining requirements.

MESSRS. T. SUGDEN, LTD, 180, Fleet Street, E.C., have sent us a copy of their catalogue, giving particulars of their superheaters, furnaces and valves.

MESSRS. SMITHSON, SHARPE & CO., Sykes Street, Hulme, Manchester, have sent us their arc lamp list for 1905. They have just completed an installation of over 150 of their single enclosed arcs at the premises of a local firm.

We have received from Mr. ALPH. STEIGER, 28, Victoria Street, S.W., the representative of Messrs. Escher, Wyss & Co., of Zurich, a nicely got-up catalogue of the latter company's well-known turbines. It contains useful and interesting references to some well-known water-power plants.

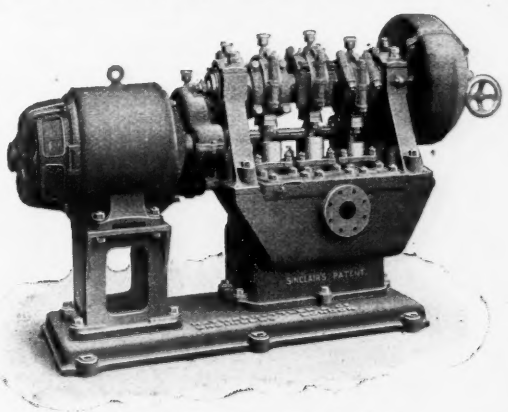
A new price list of electric radiators has come to hand from the SUN ELECTRICAL CO., LTD., 118—120, Charing Cross Road, W.C.

A new price list of moving-coil ammeters and voltmeters has come to hand from Messrs. JOHNSON & PHILLIPS, Victoria Works, Old Charlton, S.E.

The TANDEM SMELTING SYNDICATE, LTD., 97C, Queen Victoria Street, E.C., has sent us a list relating to its white metal alloys for anti-friction metals.

We have received from Mr. FREDERIC NELL, 46, Queen Victoria Street, E.C., a leaflet illustrating "Victor" turbines, pumps and condensers.

MESSRS. HAYWARD-TYLER & CO., 99, Queen Victoria Street, E.C., have issued a list describing "Sinclair's" patent electrically-driven variable stroke boiler feed pumps, of which they are the sole makers. One of these pumps we illustrate below. The pump portion does not depart from standard practice, the special feature being in the crankshaft. Instead of cranks, the shaft is provided with eccentrics, which are so arranged that their axes can be made to coincide with the axis of rotation, or they may be removed from the centre a distance corresponding to half the full stroke of the



THE SINCLAIR ELECTRIC PUMP.

plungers, or any intermediate distance. The change in the throw of the eccentrics is made while the shaft is rotating, by holding a lever or hand wheel in one of two positions corresponding to increase or decrease of stroke, releasing the same when the desired stroke has been obtained. By this means the electric motor is run at a constant speed regardless of varying the rate of discharge of water. Efficiency curves are given in the list, together with other details regarding sizes, capacities, &c., of these pumps.

THE MORRIS-HAWKINS ELECTRICAL CO., LTD., 17, Charing Cross Road, W.C., have sent us pamphlets relating to their dynamos and motors.

MESSRS. MCCLURE & WHITFIELD, electrical engineers, of the Mersey Dynamo Works, Stockport, have forwarded us one of their handy little pocket diaries, which we feel sure will be much appreciated for their useful size, arrangement and contents, including a life insurance policy.

From MESSRS. WILSON, HARTNELL & CO., LTD., electrical engineers, of Volt Works, Leeds, we have received a wall calendar of considerable artistic merit; so tastefully designed, in fact, is it that we can thoroughly congratulate the firm in its happy choice. We feel sure that the almanac will find a prominent position in many an office.

MESSRS. EVERETT, EDGCUMBE & Co. have issued a novelty in the shape of a list consisting of two hands; two fingers of one are brought into the palm of the other, laying down the law convincingly, with "It's just like this!" It brings before the recipient the fact that the firm are experts in all that appertains to measuring instruments.

Private Bills in Parliament.—At the meeting of the Thames Conservators on Monday, it was agreed to apply to the promoters of the following Bills for their undertakings to insert clauses "necessary for the protection of the Conservators' interests," and it was further agreed that in the event of such undertakings not being given, petitions should be presented against the Bills in question.—Hammersmith, City and North-East London Railway; Charing Cross and Strand Electricity Supply Corporation, Ltd. (Power Supply); Great Northern, Piccadilly and Brompton Railway (No. 1); Central London Railway (new lines); East London and Lower Thames Electric Power; Administrative County of London and District Electric Power Co.; City of London Electric Lighting Co., Ltd. (Extension of Powers); Woolwich Borough Council (Bill for acquisition of land for enlarging generating station); Metropolitan Electric Supply Co.; and Metropolitan Pneumatic Dispatch. In the case of the following Bills it was agreed that it was not necessary to take any action:—Weybridge and Walton-upon-Thames Electric Supply; Baker Street and Waterloo Railway and London United Tramways.

In the case of the following provisional orders, it was reported that Messrs. Wyatt & Co. had, as a matter of urgency, been instructed to take steps to secure certain necessary amendments:—Clewer and Old Windsor Electric Lighting; Brentford Electric Lighting (Metropolitan Electric Supply Co., Ltd.); Brentford Electric Lighting (Brentford Electric Supply Co., Ltd.); Woking (Chertsey Extension) Electric Supply Co.; and Woolwich Electric Lighting. The Parliamentary Committee reported that in the case of the following Orders they had been advised by the Parliamentary agents that the interests of the Conservators were already fully protected:—Gravesend Electric Lighting (Extension to Northfleet); and Surbiton Electric Lighting.

Standing Orders.—The Examiners resumed their consideration of Bills on Thursday last week, when the following passed the Standing Order proofs:—South Lancashire Tramways, London United Tramways, and County of London Electric Supply Co. Consideration of the East London and Lower Thames Electric Power Bill was postponed for a week. In the case of the Liverpool Corporation Tramways Bill there was no appearance, and the Examiner marked the Bill "dead."

On 20th inst., 19 Bills came before Mr. Campion, only one of them being an electrical Bill. This was the Wellingborough and District Tramroads and Electricity Supply Bill. Consideration of the Bill was postponed until February 16th next. Of the Bills which came before Mr. Jeune, Standing Orders were found to have been complied with in the following cases:—Metropolitan Railway, South Wales Electric Power Distribution, Central Electric Supply Co., and West Cumberland Electric Tramways. Consideration of the Hastings Tramway Co.'s Bill was postponed until Feb. 16.

On Monday, Mr. Campion had 16 Bills before him. The following, among others, passed the Standing Orders stage:—Central London Railway (New Lines); Blackpool, St. Annes and Lytham Tramways; Mexborough and Swinton Tramways; Shepton Mallet Gas Co. (Electric Lighting); Tyneside Tramways and Tramroads Co.; and the North-East London Railway.

Fifteen Bills came before Mr. Jeune, and those which were declared to comply with Standing Orders included the following:—Shropshire and Worcestershire Electric Power, and the Metropolitan District Railway Bill.

On Tuesday 15 Bills came before Mr. Campion, and the following were declared to comply with the Standing Orders of the House:—Andover Lighting and Power, Oldham and Saddleworth District Tramways, Metropolitan Electric Tramways, and North Metropolitan Electric Power Supply. The Hammersmith, City, and North-East London Railway Bill was down on the list, but consideration was postponed until Thursday, January 26th. Of the 15 Bills which came before Mr. Jeune, those electrical Bills which complied with Standing Orders were the Weybridge and Walton-on-Thames Electric Supply, Chelsea Electric Supply, and London Southern Tramways.

On Wednesday, Mr. Campion found that Standing Orders were complied with in the case of the following Bills:—Woolwich Borough Council, City of London Electric Lighting Co., Ltd. (Extension of Powers), Buenos Ayres Grand National Tramways Co., Bristol Corporation, Whitechapel and Bow Railway, Metropolitan Electric Supply Co. (Acton District), Baker Street and Waterloo Railway, Charing Cross, Euston and Hampstead Railway, Edgeware and Hampstead Railway, and Great Northern, Piccadilly and Brompton Railway (No. 1). The Metropolitan Electric Supply Co. (Various Powers), which is opposed, was further postponed till February 1st, and the Great Northern, Piccadilly and Brompton Railway (No. 2), which is also opposed, was adjourned till Feb. 2nd.

It was found that Standing Orders had not been complied with in the case of the Coventry Electric Tramways Bill, in which the tramways company are asking for two years' extension of the period for the reconstruction of certain tramways. The Bill will now go before the Standing Orders Committee, who will decide whether it shall be allowed to proceed.

On Tuesday, Lord Balfour of Burleigh and the Hon. Mr. Lowther sat to consider which Bills should originate in the House of Lords and which in the Commons. The following electrical Bills will originate in the Upper House:—Blackpool, St. Annes, and Lytham tramways, Central Electric Supply, Charing Cross, Euston, and Hampstead Railway, City of London Electric Lighting Co., County of London Electric Supply Co., Coventry Electric Tramways (Extension of Time), East London and Lower Thames Electric Power, Gosport and Fareham Tramways, Hastings Tramways, Metropolitan District Railway, Metropolitan Electric Supply Co. (Acton District), Metropolitan Electric Supply Co. (Various Powers), Metropolitan Railway, Mexborough and Swinton Tramways (Extension of Time), North Metropolitan Electric Power Supply, Oldham and Saddleworth District Tramways, Shepton-Mallet Gas Co. (Electric Lighting), South Lancashire Tramways, Tyneside Tramways and Tramroads, Wellingborough and District Tramroads and Electricity Supply, and West Cumberland Electric Tramways (Extension of Time).

The Bills which will originate in the House of Commons include the following:—Aberdare Tramways, Administrative County of London and District Electric Power Co., Baker Street and Waterloo Railway, Buenos Ayres Grand National Tramways, Central London Railway, Charing Cross and Strand Electricity Supply Corporation, Chelsea Electricity Supply, Dublin United Tramways, Edgeware and Hampstead Railway, Great Northern, Piccadilly and Brompton Railway (Bills Nos. 1 and 2), Hammersmith, City and North-East London Railway, London Southern Tramways, London United Tramways (Extension of Time), Metropolitan Electric Tramways, Metropolitan Pneumatic Dispatch, North-East London Railway, Shropshire and Worcestershire Electric Power, South Wales Electrical Power Distribution Co., Weybridge and Walton-upon-Thames Electric Supply, and the Whitechapel and Bow Railway.

The Miller Signalling System.—In connection with the recent accident, which occurred through fog, on the Midland Railway, the British Miller Signal Syndicate, Ltd., of 122 and 123, Salisbury House, E.C., forward us pamphlets dealing with their system, as described in the ELECTRICAL REVIEW, of February 7th, 27th, and March 6th, 1903, and pointing out that its adoption on the railway in question would almost certainly have prevented the catastrophe.

Bankruptcy Proceedings.—The case of Harry Arthur White, 45, Highgate Hill, N., lately carrying on business as Ridout and Co., came before Mr. Registrar Linklater on 17th inst., in relation to the public examination of the debtor, against whose estate a receiving order was made last November upon the petition of the General Electric Co., Ltd. Mr. Egerton S. Grey, Official Receiver, reported that the proceedings had been delayed to allow the debtor to apply to have the receiving order rescinded. The application was heard on the 12th inst., and was dismissed, but the debtor had not yet filed the statement of his affairs. Under those circumstances, he would suggest that the examination should be further adjourned. His Honour postponed the sitting for a month, and ordered the statement of affairs to be lodged within a fortnight.

The adjourned first meeting of the creditors was held on 18th inst. before Mr. E. S. Grey, Official Receiver, and it appearing that sufficient notice had not been given to the creditors, a further adjournment of one week was taken by consent. It appears from the debtor's statements that for about two years he acted as manager to Messrs. Ridout & Co., electricians, of 45, Highgate Hill, and in March, 1903, he took over the business, agreeing verbally to pay £600 by instalments for the goodwill and stock. He carried on the business on his own account, but in the name of Ridout & Co., for about a year. In May, 1903, he entered into a contract with the Hornsey Borough Council for installing the electric light and fixing ventilating fans in the Town Hall, but owing to the failure of the petitioning creditors (as he alleges) to supply materials according to specification, he was unable to complete the contract within the agreed time, and in consequence could not obtain a balance of £110 due to him from the Council. In June, 1904, he removed to Messrs. Knowlman Brothers, general furnishers, of Holloway Road, the stock from 45, Highgate Hill, as he could not afford to keep on those premises. It was his intention to come to an arrangement with Messrs. Knowlman Brothers to start an electrical department for them in their business, but it came to nothing, because he was unable to settle with his creditors, and he ultimately sold off the stock for £50 in order to pay rent and other pressing claims. The debtor has not yet filed the statement of his affairs, but he roughly estimates his liabilities at £1,000, and his assets at a few pounds only. Want of sufficient capital and undue pressure by the petitioning creditors are the reasons advanced for the failure. Mr. T. B. Lodge represented the debtor at the meeting.

A first and final dividend of 8½d. in the £ is payable on January 30th in the case of C. M. Downie, electrical engineer, trading as the Lighting Corporation, at Bloomsbury Street and Crouch Hill. The dividend is payable by C. J. Singleton, 8, Staple Inn, W.C.

At Tuesday's sitting of the London Bankruptcy Court the application of Mr. Max Margowski for an order of discharge was again before Mr. Registrar Brougham. The affairs have been referred to at length in previous issues of the ELECTRICAL REVIEW. Mr. P. M. Crawcour Hart, on behalf of the trustee, alleged that the bankrupt had been guilty of fraud in relation to the transfer of shares to his wife, but the learned registrar held that the charge had not been sufficiently proved. On the other grounds he suspended the discharge for four years from August last.

The public examination of Wm. Sumner and Edward Sumner, carrying on business at Garston and West Kirby (W. & E. Sumner,

electrical and mechanical engineers) took place at a sitting of the Liverpool Bankruptcy Court last week. The joint statement of affairs showed liabilities amounting to £844, and assets amounting to £12 17s. 8d., these being entirely composed of book debts. Wm. Sumner's separate debts amount to £169, and the assets £38 8s., and those of Edward Sumner to £16 17s. and £5 respectively. The examination was adjourned to enable debtors to file an account showing business done during the two years previous to the selling of the business to the company.

The public examination of Henry Coles, electrical engineer, 10, York Street, Swansea, is to take place at Carey Street on February 8th at 11 a.m.

Dissolutions and Liquidations.—Creditors of the Thames Valley Launch Co., Ltd., are to send particulars of their debts, &c., to the liquidator, Mr. F. J. Saffery, 14, Old Jewry Chambers, E.C., on February 14th.

Creditors of the British Columbia Telephones, Ltd., are required to send particulars of their debts, &c., to Mr. Maurice Brewer, 49, Queen Victoria Street, E.C., by February 20th.

Messrs. B. Sherman, F. H. Rogers, and D. H. Muston (Sherman, Redfern & Muston, electrical engineers and telephone specialists, 16 and 17, Devonshire Square, Bishopsgate Street Without, E.C.), have dissolved partnership.

Messrs. H. Gray and J. Rawlinson (Gray, Rawlinson & Co., asbestos and india-rubber manufacturers, 3, King Street, Liverpool) have dissolved partnership. Mr. Rawlinson will attend to debts and continue to carry on the business.

A meeting of Hodges & Todd, Ltd., is to be held at 64, Gresham Street, E.C., on February 27th, to hear an account of the winding up from the liquidator, Mr. Percy Mason.

Imports of Foreign Electrical Machinery.—Notwithstanding a falling off in December the imports of foreign electrical machinery into this country during the past year underwent a slight increase, the returns for the 12 months just issued showing a total of £558,971, as compared with only £554,643 in 1903.

Annual Dinners.—On Saturday, 14th inst., the employés of Messrs. Rawlings Bros., Ltd., held their second annual dinner at the Horseshoe Hotel, Tottenham Court Road, the chair being taken by Mr. J. J. Rawlings, one of the managing directors; Mr. G. W. Rogers, the Sloane Street manager, occupying the vice-chair. Over 100 guests sat down, and during the repast the Lenthall Concert Orchestra rendered selections. Mr. F. W. Rogers proposed the toast of the "Firm and Directors." On rising to respond, Mr. W. R. Rawlings, in a review of the various branches of the business, made full use of his opportunity to make a few humorous remarks in his own happy style, at the expense of the various heads of departments in turn, causing much merriment, and he took the opportunity of producing some appalling statistics of office details to refute the impression commonly supposed to exist among the men that the office was a bed of roses; for example, the 100,000 electric lamps sold last year required, he said, some handling, to say nothing of the 15,000 accounts sent out, and he assured them that there was after all some work done by the staff. The toast of "The Employés" was proposed by Mr. J. J. Rawlings, the chairman, who took the opportunity of making a few remarks on the working of the new insurance scheme, and pointed out that by each man paying 1d. per week, their total claims under the extra risks covered, had exceeded the premium paid. He hoped, however, this year they would not have to make any claims at all. Mr. Charles Rawlings proposed "Our Professional Friends," amongst whom he included architects, surveyors, consulting engineers, and solicitors. He said that as a rule he could get along with the three former, but endeavoured whenever possible to avoid the last. As representing the legal profession, Mr. R. Tweedy Smith responded. Mr. J. H. Wigginton, of Messrs. Taylor, Lovegrove & Co., responded on behalf of the architects and surveyors. Mr. E. G. Nicholson next proposed the toast of "The Visitors," to which Mr. J. Anderson responded.

On Friday, the 20th inst., the first annual dinner of the staff of the General Electric Co., Ltd., Newcastle branch, was held at the Continental Restaurant, Mr. J. Spence (district manager) in the chair. It was a very successful gathering, being attended by about 60, consisting of the staff, contractors, engineers and friends.

The last of a series of three annual dinners arranged by the employés of the Nottingham Tramways Committee was held last week. Mr. J. Aldworth, general manager, presided.

Brush Contracts.—The Brush Electrical Engineering Co., Ltd., have recently booked the following contracts:—Four cars complete with B.T.H. motors, for Colne and Trawden Light Railways, ordered by Messrs. Greenwood & Batley; four 60-KW. and four 25-KW. transformers, for the Midland Electric Corporation for Power Distribution, Ltd.; also 34 car-bodies and one car complete with radial action truck and Raworth's regenerative control equipment, for the West Ham Corporation.

Condensing Plant.—Among recent orders secured by the Worthington Pump Co. for condensing machinery, is one for a large cooling-tower plant for the Premier (Transvaal) Diamond Mining Co., also a complete condensing plant for Fremantle, the Amalgamated Railway and Carriage Works, two sets for the New Comet Mines, a combined set for the Malta Docks, and a similar set for the Tientsin Electrical Co. Amongst smaller sets are those required by the Walsall Electrical Co. and the San Salvador Iron Ore Co. Jet-condensing sets have also been ordered by the Lothian Coal Co., Messrs. Wailes & Son, of Birmingham, and the Paris Refrigerating Co. Large repeat orders for barometric sets have been received from the London and North-Western Railway for their steel works at Crewe, and from Messrs. Singers for extensions at Kilbowie.

Electro-Capillary Recorder.—On Friday last, the Orling-Armstrong electro-capillary recorder was exhibited at the Royal Institution, and its principal features—freedom from electrical impedance, smallness of mass of moving parts, and dead-beatness—which, it is claimed, render this system especially suitable for high-speed cable working, were explained. The recorder is also available for use on landlines, and in connection with wireless telegraphy.

Book Notices.—"Science Year-Book, 1905." Edited by Major B. F. S. Baden-Powell. London: King, Sell & Olding.—This is the first year of issue of what promises to be a most useful companion to all who are interested in scientific matters, but especially astronomers and meteorologists. It contains an almanac and diary, biographical directory, summary of progress in science, list of scientific societies, and a glossary of new scientific terms. The calendar is ingeniously arranged to be visible through an aperture in the front cover of the volume, and is combined with a memorandum of engagements. Numerous astronomical and physical data are given, with a variety of useful tables. Separate summaries of the more important advances made in the chief branches of scientific research are given, that on electrical engineering being contributed by Prof. Fleming. A large portion of the volume consists of a diary, with one page to each day, showing various data and providing for meteorological records. The book cannot fail to receive a hearty welcome.

"British Standard Tables of Pipe Flanges." Report issued by the Engineering Standards Committee. London: Crosby Lockwood and Son. 2s. 6d. net.

Mr. T. W. Sheffield, of Manchester, has sent us a pamphlet containing a reprint of his recent article on "Safety Devices for Electric Tramways," which appeared in the columns of a contemporary, and was discussed in the ELECTRICAL REVIEW at the time.

Trade Announcements.—The General Electric Co., Ltd., 71, Queen Victoria Street, E.C., announce that they have provided their private telephone exchange with operators to take down orders, &c., in shorthand.

Messrs. Hughes, Butterfield Bros., of Stechford, Birmingham, have established a department for the repair of accumulators and induction coils, as used for ignition purposes on motor-cars.

In view of the increasing demand for their dynamos, motors, arc lamps, meters and switchgear in the Tyne, Wear and Tees districts, the Union Electric Co., Ltd., have decided to open an office at 43, Grainger Street, Newcastle-on-Tyne. This office will be under the direction of Mr. James Gilman, from the head office.

Mr. Albert Dickinson has removed his electrical works from Armley to Dixon Lane Road, Wortley, and has started on a much larger scale to manufacture direct and alternating current machinery and accessories, under the same management. An order for a 150-H.P. D.C. dynamo has been received from Messrs. Joshua Wilson, of Leeds.

Mr. Edgar B. Ward, of Harrogate, has commenced business at Exchange Buildings, Eastthorpe, Mirfield, as an electrical engineer

LIGHTING AND POWER NOTES.

Barton-on-Irwell.—An application is to be made for a provisional order to authorise the Lancashire Electric Power Co. to supply electricity for public and private purposes within the rural district.

Bath.—The E.L. Committee has passed a resolution threatening to place the matter of the consulting engineer's delay in presenting a report promised for December 7th last, before the T.C.

Bishop Auckland.—The U.D.C. having received explanations as to the delay in carrying out the E.L. scheme, has postponed taking proceedings to recover the value of the bond of £100 from the Durham County Electric Supply Co. An arrangement has been made to obtain a supply of electricity from the power station of the Cleveland Electrical Power Co.

Brighton.—The town clerk, on the 19th inst., informed the T.C. that he had received the resignation of the consulting engineer to the electricity department, Mr. Arthur Wright. Mr. Wright, in his letter, did not give any reasons for his action, but it was generally understood in the Council to be in consequence of the unjustifiable attacks recently made on him in connection with the new generating station at Southwick. If the resignation is accepted it will take effect on April 18th next.

Cardiff.—The Corporation Asylum Committee, after inspecting three of the largest asylums in England, has decided to install the E.L. at the new asylum.

Chertsey.—The U.D.C. has resolved to approve of the application of the Woking Electric Supply Co. to extend the area of supply to the urban district of Chertsey.

The R.D.C. has passed a similar resolution, but has excluded the parish of Chobham from the area of supply by mutual agreement.

Continental Notes. — SPAIN. — Application has been made to the authorities of the Province of Drida for a concession to put down plant to utilise the water-power of the River Segre in the

generation of electrical energy for lighting and power purposes in the little towns of Seros, Aytona and Mealcoreig.

GERMANY.—The establishment of a central electric lighting station at Halstenbek-Pellingen (Holstein) has been decided upon.

BELGIUM.—A number of the leading electrical engineering companies in Belgium have just formed a syndicate, under the style of the Mutuella Electrique, to undertake the supply of electrical energy for lighting and power purposes, at the forthcoming Liège exhibition.

Dartford.—The U.D.C. recently refused to grant extra remuneration to Mr. Waterland, late electrical engineer, for doing what he claims to be the work of a consulting engineer during the time he held his appointment. Now Mr. Waterland's solicitors have informed the Council that they are instructed to take action to compel the payment of the claim made by Mr. Waterland. The Council will defend the action.

Durham County.—The Sunderland District Electric Tramways, Ltd., has arranged a contract for the supply of electrical power to the important collieries belonging to the Lambton Collieries, Ltd., which formerly belonged to the Earl of Durham. It is proposed to utilise electrical energy for hauling, pumping, coal-cutting, lighting and winding purposes, and for the engine works at Philadelphia. This innovation will make these collieries one of the most up-to-date in the country; they employ over 10,000 men, and have an output of over 3 million tons per annum. It is proposed to erect a large power station on five acres of land at Philadelphia, to supply the workings; and the tramways, of which over 12 miles are now fully completed, will be supplied with the necessary power, as well as the U.D. of Houghton-le-Spring and Hetton-le-Hole and the R.D. of Easington for lighting purposes, for which the company has statutory powers. Energy should be available at a very cheap rate, the generating station being situated on the coal-fields, and it will, no doubt, be taken advantage of by other industrial concerns. The contract has been arranged by Messrs. Harper Bros. & Co., consulting engineers, of London, and Messrs. D. Balfour & Son, engineers, of Newcastle-on-Tyne, and an immediate start is to be made with the construction of the power station.

Farnham.—The Urban Council has decided to inform the Farnham and District Electric Supply Co. that the Council will not offer any opposition to its provisional order, provided that it agrees to insert a clause giving the local authority power to purchase the undertaking in 21, 28, or 35 years.

Faversham.—The T.C. has altered the charges and rebates for energy as follows:—To consumers of 75 units per quarter, 6d. per unit, with a discount of 5 per cent. if paid within a month; over 125 units per quarter, 5d. per unit; over 250 units, 4½d.

Gravesend.—With regard to the opposition of the Northfleet U.D.C. to the T.C.'s application for powers to supply electricity to Northfleet, the T.C. has informed the B. of T. that the U.D.C. has done nothing towards carrying out the Order, adding that it is unfair that a local authority which is unable or unwilling to give a supply itself, should prevent others from doing so. It is also pointed out that Northfleet's terms for consent to the application are onerous.

Heckmondwike.—The Council is seeking power to borrow £15,000 for the payment of contracts on hand in connection with the electrical undertaking, £7,500 being for future use. It is proposed to supply electricity in bulk to other townships, or direct to consumers in adjacent parts of such townships. Heckmondwike is bounded on one side by the Batley Borough, and on the other by the Liversedge Urban District. It is understood that the Bill will be opposed by the Batley Corporation and the Liversedge Urban District Council, and also by the Yorkshire Electric Power Co., who have all presented memorials complaining of non-compliance with the Standing Orders.

Herefordshire.—The County Council Asylum new electric installation has been completed at a cost of £5,823, a saving of £177 over the estimated amount.

India.—BOMBAY.—From a local source we learn that the Brush Electrical Engineering Co. has been making good progress in the erection of the new power house at Mazagon. Messrs. Callender's Cable and Construction Co. had £20,000 worth of cables stacked on the Crescent recently. Plans for the laying of the cables were deposited with the municipal authorities, and the company was only awaiting their approval, in order to commence work. It is expected that energy for lighting the Fort will be available at the end of the present month.

KASHMIR.—According to the *Madras Mail*, the power station in connection with the large project for supplying the district with electric power will probably be erected at Rampur on the Jhelum River, where, with a six-mile feeder channel, it has been found practicable to obtain a fall of about 450 ft., giving 100,000 H.P. with the minimum flow of the river. It is suggested, as possible, that the Kashmir Railway of 180 miles in length, will be operated by electricity, and that power for industrial purposes will be available at Srinagar, Abbottabad, Murree and Rawalpindi. Electrically operated dredgers are projected for deepening the river in the Kashmir Valley, to minimise the floods which now devastate the place periodically.

NILGIRI CORDITE FACTORY.—The *Advocate of India* states that Major-General Sir Edmund Ellis, on November 19th, opened the hydro-electric installation in connection with the Government cordite factory. Sir Edmund stated that from this factory, ammunition, cordite and cartridges could be supplied to all the troops in India. The factory is situated at Aruvankad, and the power house at Katary, in the Nilgiri Hills. The work has been carried out by the General Electric Co., "of England," under the direction of Mr. Molesworth.

GT. I. PEN. RAILWAY.—A new train of six bogie coaches has been recently built for suburban service at Bombay, and is lighted throughout by electricity on the Vicarino system. The storage batteries used are of a special train lighting type, supplied by the Bombay Electric Co. Electric fans are also provided on the first-class coaches. Other trains, similar to the above, are now under construction.

JAMALPUR.—The provision of electric power for the locomotive workshops of the E.I. Railway, has been sanctioned at a cost of 2 lakhs 60,000 rupees.

Kent.—At a conference of Kent public authorities, convened by the Bromley Corporation, it has been decided to oppose the City of London Electric Power and the Administrative County of London and District Electric Power Bills.

London.—L.C.C.—The Theatres Committee reminded the Council of the regulations which require that two systems of lighting should be provided in places of public entertainment, and that if two systems of electric lighting are given, the supply should be obtained from separate companies. In this connection the Committee stated that the Charing Cross and Strand Co. had asked that the two systems which it had made arrangements to supply, might be regarded as complying with the regulations of the Council. The company was able to supply not only the exit and corridor lights as required, but also with complete alternative supplies, respectively available by means of change-over switches on the two systems, for the entire installation. One source of supply was the company's generating station at Lambeth, and the other its station at Bow. The Committee recommended the Council to approve the scheme of dual service for a period of three years on the following conditions:—

1. That at least one sub-station, such as that of Short's Gardens, in addition to St. Martin's Lane, be maintained and kept at work at all times.

That the "ordinary" and the "theatre" sets of mains, and the machinery and apparatus connected with them be kept absolutely and entirely separate and distinct, and both always available.

2. That where this separation is not at present complete, it shall be made so.

3. That the feeders and other mains on each system will be able at all times to carry the extra load in the event of the other system breaking down from any cause, and that the plant supplying these two stations will also be adequate for the maximum load which can come on it, under such circumstances.

4. That sufficient power be always maintained at Bow, to meet any possible demands on the "theatre" mains owing to a break down at Lambeth.

5. That the duly authorised officers of the Council be allowed to inspect these stations and sub-stations from time to time, without notice being given in advance of such inspection.

6. That it be understood that the above conditions are to be read as having been drawn up with the object of ensuring that a separate supply from two independent sources shall always be available for instant use at all theatres and places holding music or dancing licences, and that the separation of the two systems shall be so complete that no break down in one shall involve the extinction of the other supply.

POPLAR.—As a reason why no money should be transferred to the rates from the present credit balance of the electricity undertaking, the borough electrical engineer has reported to the Finance Committee that it is not advisable to assume that the profits this year will meet all liabilities on account of capital charges; repayments of loans must be paid out of the surplus to March last. If repayments had not been deferred from 1901-1902-1903, there would have been a deficiency of £2,455, instead of a surplus, as at present, of £6,893. The repayment of loans this year amounted to £3,045, as against £803 for last year, and the amount of repayment deferred until next year is £1,777. The sum due for 1905-6 on moneys borrowed, will amount to £4,363. The public lighting is not dealt with, this having been transferred to the general borough fund as from April last. On the reduction in price of energy for public lighting, up to September 30th, a saving to the borough of £1,049 has been effected, and the reduction in the power rate to consumers, will, it is estimated, reduce the revenue by about £700.

The Electricity Committee has adopted the recommendations of its electrical engineer, to extend the plant at the generating station, *i.e.*, by a new boiler at a cost of about £2,500; ash elevator, £80; and steam feed pump, £350.

In connection with tests being conducted on Nernst lamps for public lighting, two streets are to be lighted by ½-ampere lamps to enable comparison with ½-ampere lamps installed in an adjoining street. 15 more arcs are to be erected for street lighting at Millwall, at an estimated cost of £375.

HAMMERSMITH.—A main is to be laid to supply energy to the railway arches, Wood Lane, at an estimated cost of £680. £499 is to be spent on providing a transformer pillar and a main to supply the London Bishopric Estate.

The *Daily Telegraph* says that the electric light and power plant of the new Clement-Talbot Motor Works in Ladbroke Grove is very extensive and complete. Messrs. Willans & Robinson have supplied one of their "Rugby" vertical gas engines. It drives a Siemens

six-polar, continuous-current, shunt-wound dynamo. Messrs. Bergtheil & Young have supplied an 8-KW. dynamo-driven by a 14-H.P. National gas engine. There are three—20 H.P. motors in the machine shop, one of 5½-H.P. driving a pump in connection with the sand-blast plant, a 10-H.P. motor for driving a ventilating fan, and others for various purposes. There are 80 Bandy 1,000-C.P. arc lamps for lighting the workshops, and 200 incandescents for lighting the offices. A gas producer plant of 500-H.P. capacity has been installed by Messrs. W. F. Mason, Ltd.

BETHNAL GREEN.—A report was presented from the conference held at Shoreditch, with reference to various electric power Bills which are to be presented in the ensuing session. That conference was unanimous, and it was agreed to appoint a joint committee to oppose the Bills. It was thought, however, that it would be better for the Council to hold its hand for a while and see whether, as last year, it could get the London County Council to include it in its opposition. The matter was referred to the Law and Parliamentary Committee.

London Electric Power Bills.—The Middlesex D.C.'s Association held a meeting on the 9th inst., when representatives of the Borough of Ealing, the U.D.C.'s of Acton, Chiswick, Feltham, Hampton, Staines, Hanwell, Heston and Isleworth, and Twickenham, and the Staines R.D.C., were present, and discussed the above Bills. It was resolved, if possible, to promote a joint opposition, the expenses to be divided on the basis of the assessable value.

Newcastle.—A deputation recently waited upon the City Lighting Committee of the Corporation, and urged the desirability of an extension of the electric street lighting, consisting of 180 lamps for Callowgate, Elswick Road, and Barrack Road. The Tramways Committee already supply 200 arc lamps at a cost of £15 10s. per annum each, but if they were allowed to take over the extra 180 lamps, the charge would be reduced to £12 each. The subject was adjourned for consideration.

New York City.—Evidence is being collected on the alleged excessive cost of public electric and gas lighting, but no real information from the representatives of the New York Edison Co. is to be obtained. Mr. Charles E. Phelps, of the Municipal Lighting Commission of Baltimore, Md., has testified that New York pays about 40 per cent. more than that city for its electrical supply. Tables of comparative cost have already been published in these columns.

Rawtenstall.—Another six months' extension of time for carrying out the E.L. provisional order, has been granted to the T.C. by the B. of T.

Runcorn.—In the *London Gazette* for January 24th the full terms are given for the transfer of the U.D.C.'s prov. order to the Mersey Electric Supply Co., of Liverpool.

St. Andrews.—The T.C. has decided, before considering the matter of street lighting by electricity, that a deputation shall visit Edinburgh and Dalkeith to obtain information.

South Bank.—The Cargo Fleet Iron Co., Ltd., has offered to supply electricity in bulk to the U.D.C. at a cheap rate. The Council has decided to ascertain what would be the cost of laying down distributing plant.

Southampton.—The borough electrical engineer in a report recently issued gives the cost of the construction of the new generating station on the Western Shore. The total being £21,955, which exceeds the loan obtained by £4,370. The building cost £15,192, piles and concrete mattress and foundations £3,456, and chimney £3,285. L.G.B. sanction is to be obtained to borrow £6,300 to cover the excess expenditure over the loans sanctioned.

Southend.—The T.C. has decided to erect an additional 10 arc lamps for street lighting, at a cost of £128.

Stourbridge.—The U.D.C. has resolved to give general support to the Bill being promoted by the Midland Electric Corporation, to enable it to supply energy in bulk within the Council's area.

Swansea.—The Electricity Committee has resolved that as from April 1st next the charges for electricity be as follows:—For lighting, 6d. per B. of T. unit for the first hour's daily consumption of the maximum demand, and 2d. per unit subsequently, provided that in no case is the charge to exceed 5d. per unit; for power, 2d. per B. of T. unit for the first hour, and afterwards 1½d. per unit.

Taunton.—The T.C. has arranged with Messrs. Langdon-Davies for the supply of motors on sale or hire or hire-purchase.

Whitwell.—A public meeting has been held to consider the advisability of forming a company to provide electric lighting in the village. Mr. Mountain, of Huddersfield, has prepared two schemes. The matter was adjourned for further consideration.

Willesden.—A memorial has been presented to the Examiners of Private Bills in both Houses by the U.D.C. against the Metropolitan Railway Bill, in regard to Clause 35 of that Bill. By this clause it is proposed to enact that: "The company may enter into and carry into effect agreements with any other railway company or any company for the time being authorised by special Act or provisional order confirmed by Parliament to supply electricity, for the supply of electricity for traction, lighting, or other purposes." The D.C. contends that this clause proposes to repeal, without proper notice, the proviso to Clause 31 of the Metropolitan Railway Act, 1902, which is as follows: "Provided that the company shall not use, or supply for use, in the Parish of Willesden electricity or electrical power except for the purpose of their own undertaking." Any proposed alteration or repeal of this proviso ought, it is contended, to have been served upon the memorialists, and the failure of the company to do so is, it is alleged, a non-compliance with the Standing Orders.

TRAMWAY AND RAILWAY NOTES.

Barry.—A movement is on foot to promote a Bill in Parliament next session for the lighting of the district with electricity, and the establishment of electric tramways.

Belfast.—A partial beginning of the conversion of the tramway system was made on the 23rd inst. by the contractors, Messrs. J. G. White & Co., London.

Birmingham.—The Dolter Electric Traction Co., Ltd., are this week exhibiting a working model of their surface-contact system as at present in use in Paris and Dresden, and about to be installed at Torquay. The company offer, it is understood, to work an experimental line in Birmingham on easy terms, should they be able to secure the favour of the City Council. The Tramway Bill commits the city to no particular system.

Bradford.—The City Council recently discussed the discretionary powers of the general manager of the tramways department to suspend or discharge employés. The Tramways Committee has since decided to allow the principle of appeal to the Committee in cases of dismissal, and a sub-committee, including the chairman and deputy-chairman, was appointed to formulate rules under which appeals may be entertained by the Committee.

Dudley.—A fire was discovered on Thursday morning last week, in the tramway depôt, and before it was extinguished damage was done to the extent of between £400 and £500.

German Railways.—It is stated that numerous schemes are in contemplation for the construction of electric railways in Germany. These include the following lines:—Berlin—Hamburg, Frankfort—Wiesbaden, Cologne—Düsseldorf, and Leipsic—Halle.

Germany.—Electric tramways are to be constructed in the Aix-la-Chapelle district, the length aggregating 66 kilometres.

Glasgow.—The general manager of the tramways has been instructed to proceed with the construction of the remaining portions of the tramways in Clydebank authorised by the Clydebank Burgh Tramway Order, 1901.

Gorton.—The U.D.C. is seeking powers to construct tramways (single track with passing places) from the Manchester city boundary, along Gorton Lane and Wellington Street to Hyde Road, and from Hyde Road along Reddish Lane to the boundary of the Gorton Urban District.

Huddersfield.—The tramway receipts for the nine months ending December 31st were, according to a report lately presented to the Town Council, £54,095, and the balance of profit, after payment of interest on capital and allowing £7,991 for redemption of debt, was £8,857. No provision, however, is made for depreciation. This is said to have been Huddersfield's best record.

India.—The Simla Municipality has voted funds for the construction of a mono-rail tramway from Sanjouli to the Simla Ridge.

Italy.—A company has just been formed in Brussels with a capital of £50,000, to be known as La Compagnie Italo-Belge des Tramways Electriques de Verona, to construct and work a system of electric tramways in the town of Verona. The object of the company is to aacuire the tramways (about 4 km. in length) in the town of Verona and convert the same to electric traction on the overhead system and to construct a further 4 km. of lines.

Lancaster.—The Tramways Committee is considering the desirability of running motor 'buses in portions of the town not tapped by the trams at present. Tenders are to be invited for the removal of the tramcar-shed to the upper end of Thurnham Street. The estimated cost is £1,100. The car-shed at present occupies part of the site of the new town hall.

Metropolitan Railway.—The report for the last half-year states:—"The installation at the power station, Neasden, is so far completed as to enable a service of passenger trains to be run between Baker Street and Uxbridge, and the number of such trains is being gradually increased. This working was commenced on January 1st, and it is intended shortly to run the whole service on this section by electrically-driven trains. The work on the inner circle is being proceeded with rapidly, and electric traction will follow on there as soon as the equipment is finished."

New South Wales.—The Sydney tramway revenue for the December quarter was £290,926, compared with £207,667 for the same quarter in the previous year. The expenditure was £190,113, compared with £179,642.

New York City.—The "Hudson Companies" has been incorporated, with a capital of $21,000,000, for the purpose of acquiring the property of the two tunnels now in course of construction under the Hudson River to connect Manhattan with Jersey City, and to be used for electric traction. The same company will also construct certain subways authorised in New York City to connect with the tunnels. These tunnels are entirely independent of the double tunnel of the Pennsylvania Railroad. The construction of the Pennsylvania Railroad tunnel is under the control of Mr. Charles M. Jacobs, an Englishman, who has been associated for many years with the enterprises of Sir Weetman D. Pearson. Mr. Jacobs has introduced into his present work several English methods.

Walsall.—The report of the Tramways Committee on the past year's working of the municipal trams has just been issued; the accounts, which are made up to December 31st, show a profit of £2,269 after payment of all charges, including interest and provision for sinking fund. The profit, the Committee strongly recommends, should be carried to a reserve fund, as it believes it will be a sound policy to build up such a fund to the maximum amount allowed by the Walsall Corporation Act.

West Ham.—At the meeting of the Corporation on Tuesday, the town clerk reported that the B. of T. had sanctioned the borrowing of the following sums for electrifying the High Street, Romford Road, and Leytonstone Road lines of tramway:—£29,850 for the permanent way; £10,100 for electrical equipment; and £18,550 for the provision of cars.

Wigan.—A poll of the ratepayers is to take place on various schemes involving an expenditure of money by the T.C., among them being the proposed purchase of certain sections of the South Lancashire tramways.

TELEGRAPH AND TELEPHONE NOTES.

French Submarine Cables.—In the course of an interesting article on this subject the *Morning Post* of January 16th says:—"There are indications that renewed pressure is to be brought to bear on the French Government in connection with the question of the French submarine cable system. In November, 1903, the Chambers voted a Law authorising an expenditure of 22,975,000 fr. on the construction and laying of four submarine cables, which were eventually to form part of a scheme for endowing France with a general system of submarine telegraphs which would free her from her dependence on the British systems. These lines were (1) from Brest to Dakar, on the West Coast of Africa; (2) from Madagascar to Réunion; (3) from Réunion to Mauritius; and (4) Saigon to Poulo-Condor and Pontianak. The lines from Brest to Dakar and from Madagascar to Réunion, going from French territory to French territory, were to be worked by the State. This programme was far from satisfying the demands of the more insistent advocates of cable extension, but the complaint is now being made that even this modest and insufficient instalment is not being put into execution with anything like the promptitude which the importance of the matter demands.

"M. Jacques Siegfried, who has from the first been prominent in pressing this matter on the attention of the Government, has recently prepared a report for submission to the Committee of Foreign Commerce inviting the Committee to adopt a resolution to the effect that, the projected construction of a system of cable communication being a question of national defence, the Committee directs the attention of the Minister of Commerce, Posts and Telegraphs to the urgency of the work.

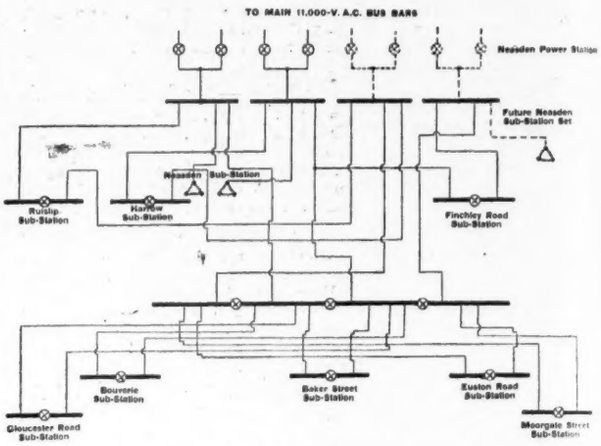
"To bring into relief the apathy of France, M. Siegfried briefly passes in review the additions which other countries have made to their submarine cable systems during the past four years. Between 1901 and 1904 Great Britain has constructed a new cable 7,530 miles in length between South Africa and Australia, and has linked Vancouver with Australia by a trans-Pacific line 7,500 miles in length, thus completing the girdling of the globe by a British line. Thus, against the 1,204 miles constructed by France, Great Britain has constructed 15,300 miles of new cables. The United States, during the same period, has laid down a cable 7,840 miles long, between San Francisco and the Philippines, which it is proposed to continue to China and Japan. But it is the advance made by Germany to which M. Siegfried directs special attention, for Germany is, he says, literally taking the place which France ought to occupy in respect of submarine communications."

Glasgow Telephones.—The general manager of the Corporation telephones has been instructed to appoint a switch-room superintendent at a salary not exceeding £3 a week.

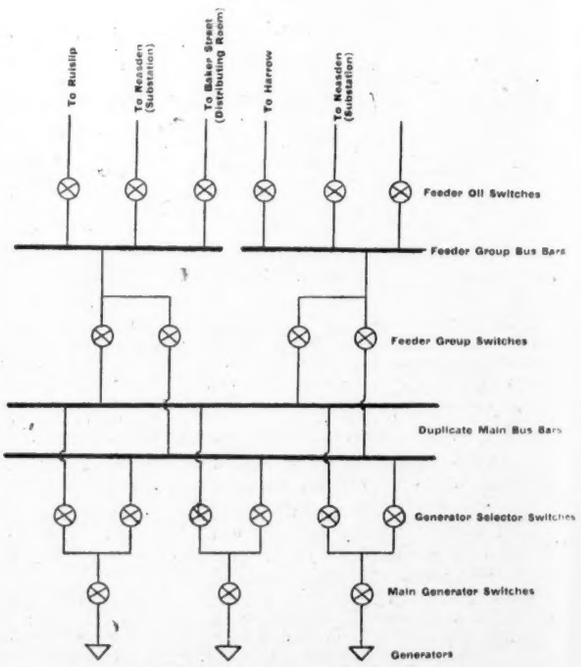
The Sub-committee has recommended (1) that the present call-wire system should be gradually superseded, and that in lieu thereof the automatic calling and clearing lamp system should be adopted; (2) that, in the first place, the new system should be applied to the Hillhead Exchange, the probable cost of which is estimated at £1,500, and (3) that offers be invited for carrying out the necessary works.

India.—To meet the growing traffic, the Telegraph Department is carrying out large extensions to the extent of a total length of about 7,500 miles of wire throughout India and Burmah. There has been a large increase in telegraphic messages since the introduction of the 4-anna rate.

Time Signals.—The *Daily Graphic* states that time signals were sent on New Year's Eve from the Washington Observatory to the Sydney Observatory, with the co-operation of the telegraph administrations concerned. The mean time occupied in the transmission of four signals was 3·14 seconds. The mean of three signals was 2·90 seconds. The distance between Sydney and Washington is over 12,000 miles.



METROPOLITAN RAILWAY: DIAGRAM OF CONNECTIONS TO SUB-STATIONS. (See p. 144.)



METROPOLITAN RAILWAY: DIAGRAM OF CONNECTIONS IN GENERATING STATION. (See p. 143.)

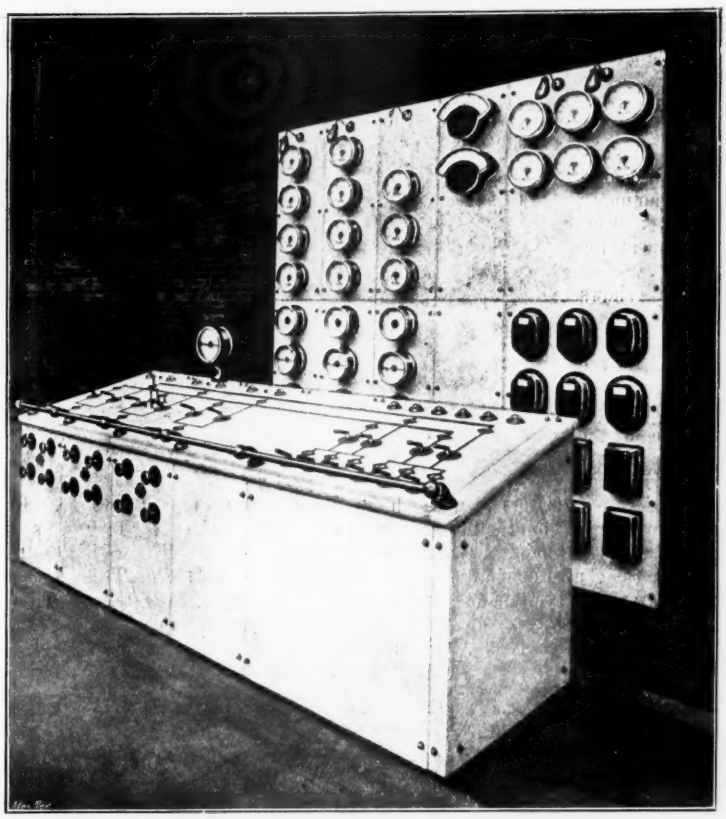
Nigerian Telegraphs.—The *Standard* says that Captain J. P. Moir, D.S.O., R.E., who is being dispatched by the Colonial Office in charge of the telegraph construction in Southern Nigeria, will leave England on Saturday for Lagos. He will be followed in a fortnight by a party of non-commissioned officers, who will superintend the working parties on the line of construction. The actual work of construction will begin in March with the lines on the delta of the Niger, so that the portion of the work in the swampy country can be got well in hand before the rains commence. The work involves the erection of some 400 miles of telegraph line, and will occupy a year. When completed, Calabar and Lagos will be connected by land wires, independent of the existing sea cables. From a point on the line between Calabar and Bonny the line will be carried to Onitsha, on the Niger, and thence to Benin, Warri, and Lagos, where it will effect a junction with the telegraph line to Kano and Sokoto.

(*Continued on page* 147.)

THE ELECTRIFICATION OF THE METROPOLITAN RAILWAY.

(*Concluded from page* 64.)

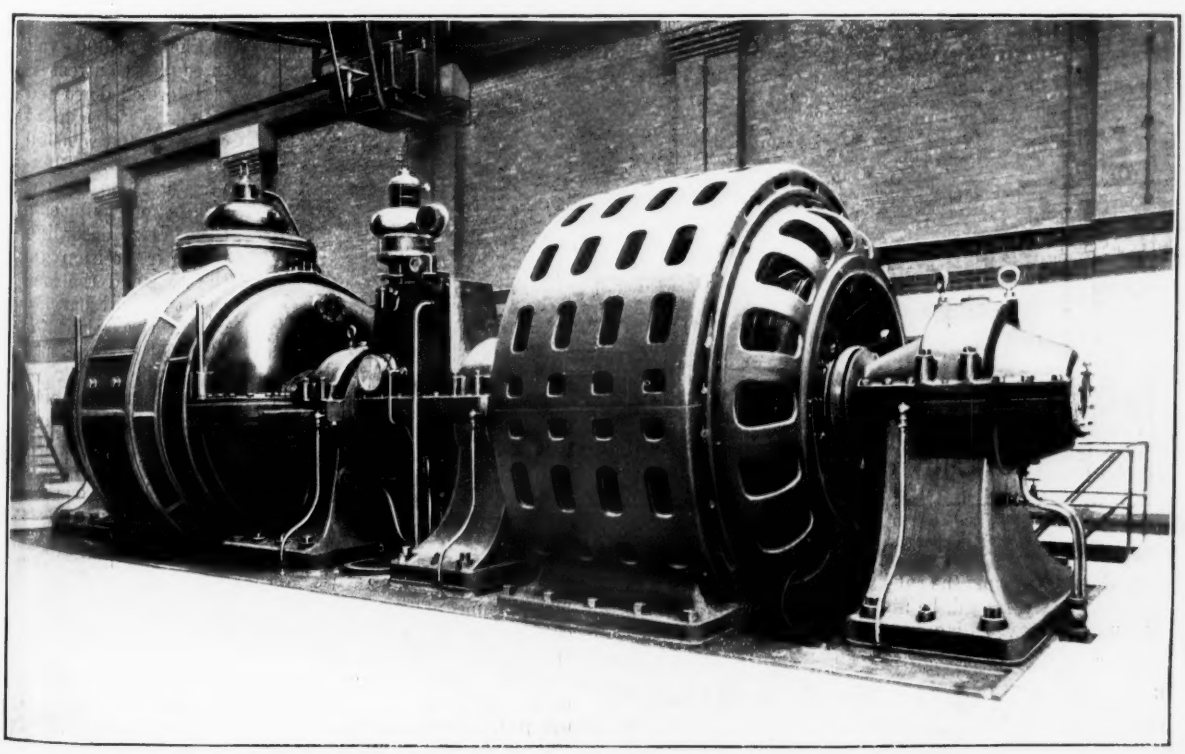
The switchboard, which is illustrated herewith, is of the desk type with an inclined top. On this is fixed the remote control apparatus for operating the main alternator, feeder, and field switches, and the electrically operated resistances and turbine governors. On the top of the desk is drawn a diagram of the connections, showing the generators, bus-bars and switches, and thus the attendant has always before him a clear representation of the conditions under which the station is working; this is a very commendable feature, and one that might be adopted with advantage in all stations of any considerable size.



Control Switchboard and Instrument Board.

Behind the desk is seen the instrument board, fitted with ammeters and voltmeters, power factor indicators, indicating and integrating wattmeters, excess current relays, &c. Indicators on the control board automatically show the position of each of the switches electrically controlled therefrom.

The switchboard connections are shown in the accompanying diagram (p. 142). It will be seen that there are two sets of main bus-bars, to either of which the generators may be connected with the aid of two switches in series; the one next to the machine is a simple main circuit oil-break switch, and the other, between this and the bus-bars, is the selector



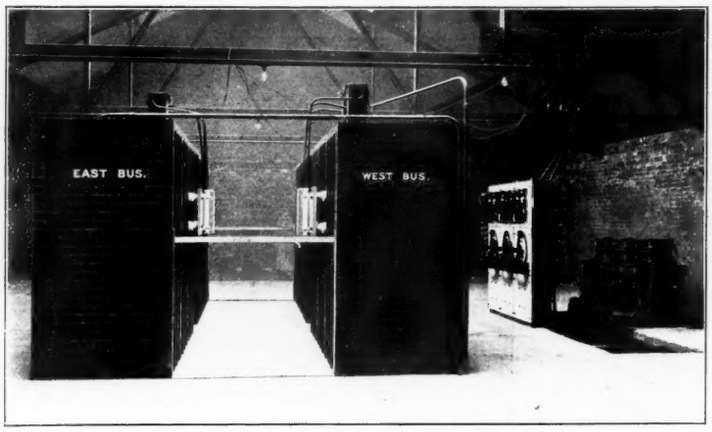
Neasden 3,500-kw. Westinghouse-Parsons Turbo-alternator, 4-pole, 1,000 r.p.m., 33⅓ Cycles per Second.

switch for connecting the generator to either set of bus-bars. In addition, isolating switches are provided and placed, electrically, right on the bus-bars to allow for the safe inspection or repair of the controlling apparatus. By closing both of the selector switches it is possible to operate with both sets of bus-bars in parallel.

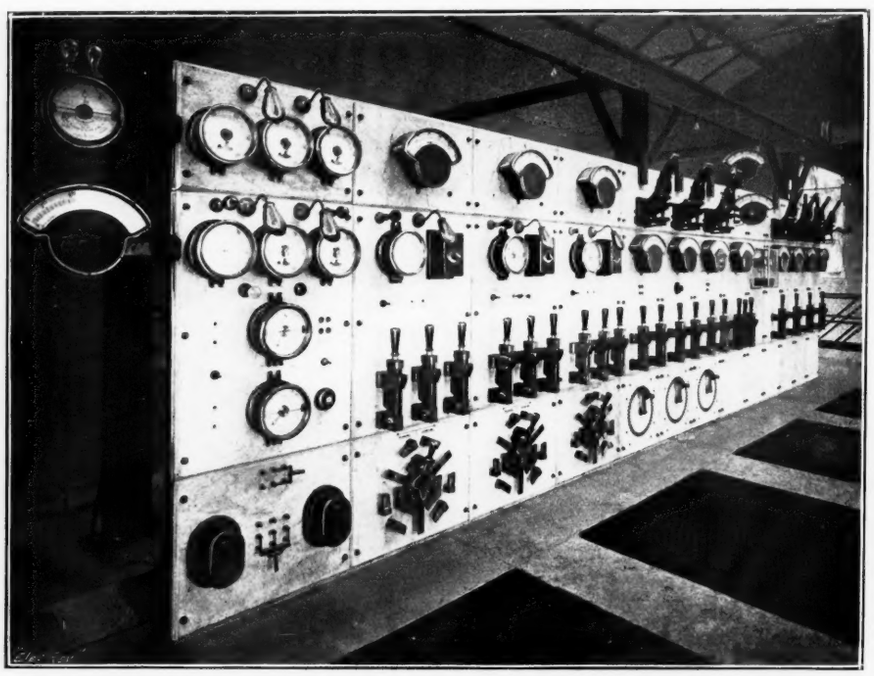
The same arrangement holds good in the feeder circuits, which, as shown, may be connected to either or both sets of bars. On the separate rheostat or control board there are duplicate sets of D.C. bus-bars, from which the exciting current is taken through two main double-pole quick-break switches to the generator field. These two switches are electrically-operated, and may be used either singly or in parallel. In connection with them the usual discharge resistance is provided. A field ammeter and an electrically-operated regulating resistance complete the equipment for each generator exciting circuit.

One of the acompanying views shows the brick compartments, which contain the bus-bars and their connections, together with the exciter board, and the rheostats for the field magnet circuits of the exciters and generators respectively; another (p. 145) shows some of the high-pressure oil switches, which are closed by long-pull solenoids, and opened by tripping coils which actuate the hammers seen in the illustration. These switches are situated on the floor below the switchboard gallery, and below this again, on the same floor level as the generators, are the generator main switches. Here also are the transformers, rotary converters and switchgear forming the Neasden sub-station plant.

The arrangement of the outgoing feeders is shown on one of the diagrams given on p. 142.



H.T. BUS-BARS AND EXCITER BOARD.



SWITCHBOARD AT HARROW SUB-STATION.

At the present time the sub-stations are not all completed, but ultimately there will be nine, which will come separately into use as occasion requires. They will be equipped as follows:—

Ruislip ...	... Two	800-KW. rotaries with transformers, &c.
Harrow ...	... Two	" " " " " "
Finchley Road	... Three	" " " " " "
Gloucester Road	... Three	" " " " " "
Baker Street	... Three	1,200 " " " " "

When extensions become necessary, Baker Street, Finchley Road, Harrow, and Ruislip will each be allotted another rotary converter of similar size to those originally installed.

From the power station four cables run to Harrow, two of which continue to Ruislip. In the other direction, five run to Finchley Road, where one ends and another is tapped off, continuing its course with the remaining three to Baker Street, where they terminate. From Baker Street eight cables run to the other four sub-stations of Gloucester Road, Bouverie Street, Euston Road, and Moorgate Street, two feeders to each; thus, Baker Street, when finished, will be a highly important station, as it will control all the Metropolitan Inner Circle traffic.

The whole of the cables have been supplied by the British Insulated and Helsby Cables, Ltd., of Prescot; they include about 75 miles of three-core 11,000-volt three-phase armoured cable, laid on the solid system from Uxbridge to Finchley Road, and on brackets from there to Baker Street, as well as in the circle tunnels.

The 11,000-volt three-phase current is transformed down and converted to D.C. at approximately 600 volts by rotary converters. Though the sub-station equipments vary in size according to their position on the line and the load that they will have to carry, the plant is identical in type and as far as possible in arrangement, having all been designed and installed by the British Westinghouse Co. The two sizes of rotary converters employed, 800 KW. and 1,200 KW., have respectively 10 and 12 poles, and run at speeds of 400 and 333 r.p.m. The transformers used in connection with them are of 300 KW. and 435 KW. capacity per phase, and are of the oil-insulated self-cooling type.

A good idea of the general lay-out of the sub-stations is conveyed by the vertical section on p. 147. The rotaries occupy the ground floor, and in some cases a railway siding is brought right into the building in order to facilitate the erection and replacement of machinery.

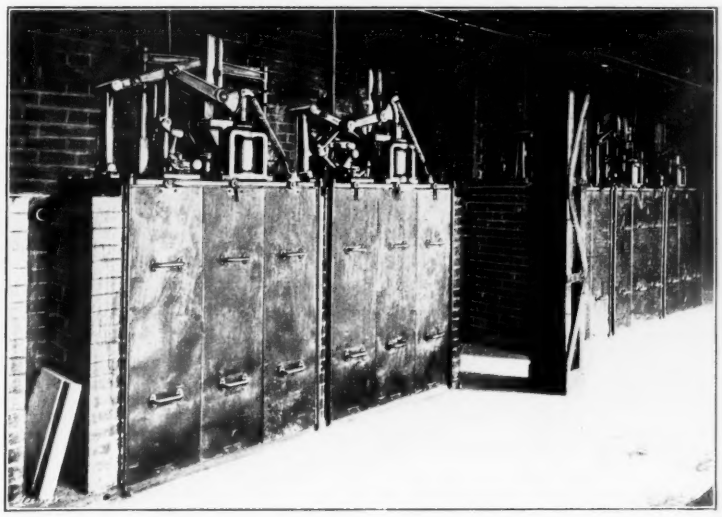
The switchboards, oil switches, and transformer chambers take up by far the greatest space, and are arranged in the manner indicated in the illustrations. Each transformer is placed centrally in a separate well-ventilated chamber, with its low pressure side facing the door, and a large air shaft common to all the chambers provides for a through draught. In the ceiling of the chambers, which is the floor of the upper gallery, large iron manholes are inserted to allow of the transformers being withdrawn if necessary; a hand-power travelling crane being in most cases provided for this and other similar purposes.

On the ground floor, behind the transformer chambers, is a passage containing the high-pressure oil-break switches, and at the back of this are the cable ducts through which the 11,000-volt feeders enter the building, and the track feeders leave it. The lightning arresters are situated here, on the end of each cable, in separate brick partitions.

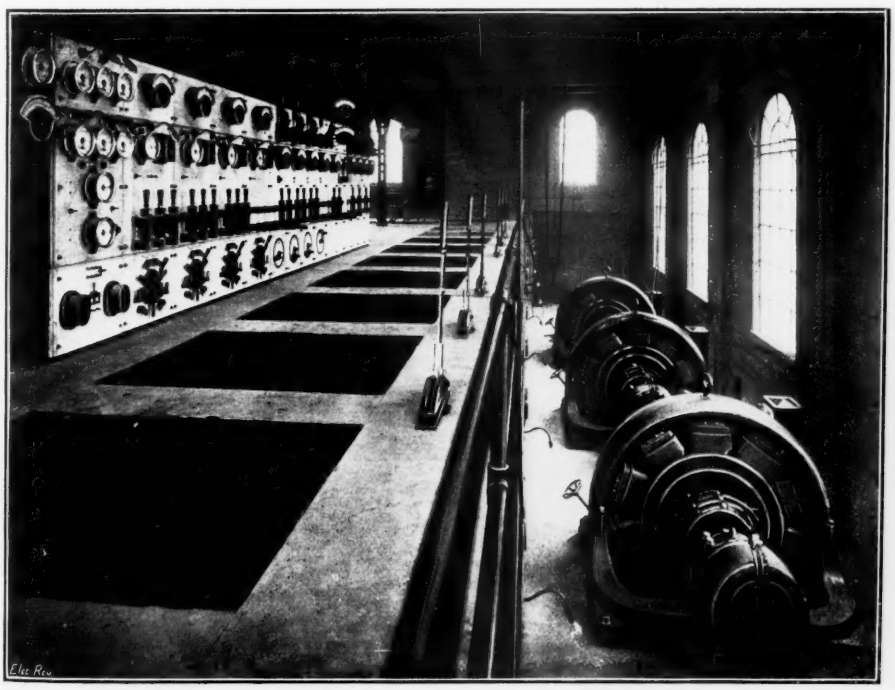
All the high-pressure switches are hand-operated through gearing by means of levers placed close to the edge of the upper gallery, and in the case of those used in the rotary circuits, are provided with time limit relays, while automatic reverse current relays are installed in connection with the D.C. feeder switches.

Electrical tripping arrangements are placed both on the switchboard panels on the gallery, and on the main levers.

The high-pressure bus-bars, of thin copper strip, are contained in brick chambers situated directly over the oil switches. They are supported on substantial and effective insulators, and access is obtained to them through iron doors, normally closed.



Electrically Controlled H.T. Oil Switches at Neasden.



Interior of Sub-station at Finchley Road.

The low-pressure and operating switchgear is contained on several marble panels, placed well in front of the bus-bar chambers in the upper gallery. They are very ornamental in appearance, and quite simple in electrical design. Referring to the view of the Harrow board, the first panel on the left contains sundry measuring and synchronising instruments, the next three the rotary converter A.C. side starting, motoring and switching gear. Following these are three panels for the D.C. side of the rotaries, containing circuit-breakers, shunt-regulating resistances, &c., and next the 11,000-volt feeder and four track feeder panels.

The lighting of each sub-station is effected from a separate small transformer tapped direct off the feeders, and in addition an efficient gas supply is laid on to cope with the remote possibility of entire failure of the current. This latter point is an example of the forethought that has been brought to bear on the design and construction of the sub-stations, where reliability has been made the essential feature.

The low-pressure lead-covered rubber-insulated cables for making the connections with the positive and negative rails were supplied and laid by the British Insulated and Helsby Cables, Ltd.

The new rolling stock of the Metropolitan Railway is all of the corridor type, with longitudinal and transverse seats. Each car is 52½ ft. long, and is mounted on two pressed steel, four-wheel bogie trucks of English manufacture; its weight is approximately 39 tons. Each motor-car, of which there are two in a train of six coaches, is equipped with four 150-H.P. ironclad British Westinghouse railway motors, one for each axle of the truck; there will therefore be the unusual amount of 1,200 H.P. available for propelling the train.

The collecting gear carried on the motor car is installed on both sides, as the current rail is not always on the same side, and a similar arrangement is fixed to a beam in the centre of the truck for making contact with the return rail, which is insulated, and is not connected with the track rails.

The Westinghouse quick-acting brake is fitted to all the

trains, and works automatically in conjunction with the unit switch arrangement of control.

The power and lighting wiring of the cars is carried out upon the soundest principles, with all conceivable precautions against fire. The cables are laid in asbestos grooves, filled in with a fire-proof composition supplied by the Calmon Asbestos and Rubber Works, and covered with sheet asbestos.

The internal arrangement of the cars has been well considered, and the scheme of decoration is of a high order. First and second-class cars have been provided, differing but little in their appearance.

Sliding doors are fitted at the ends of the cars, and patent swing gates give ready and ample access to the station platforms. All the rolling stock has been built at Birmingham and Manchester by the Metropolitan Amalgamated Railway Carriage and Wagon Co., Ltd., under the immediate supervision of the railway company's carriage and wagon superintendent, and the entire electrical equipment has been designed and installed by the British Westinghouse Co.

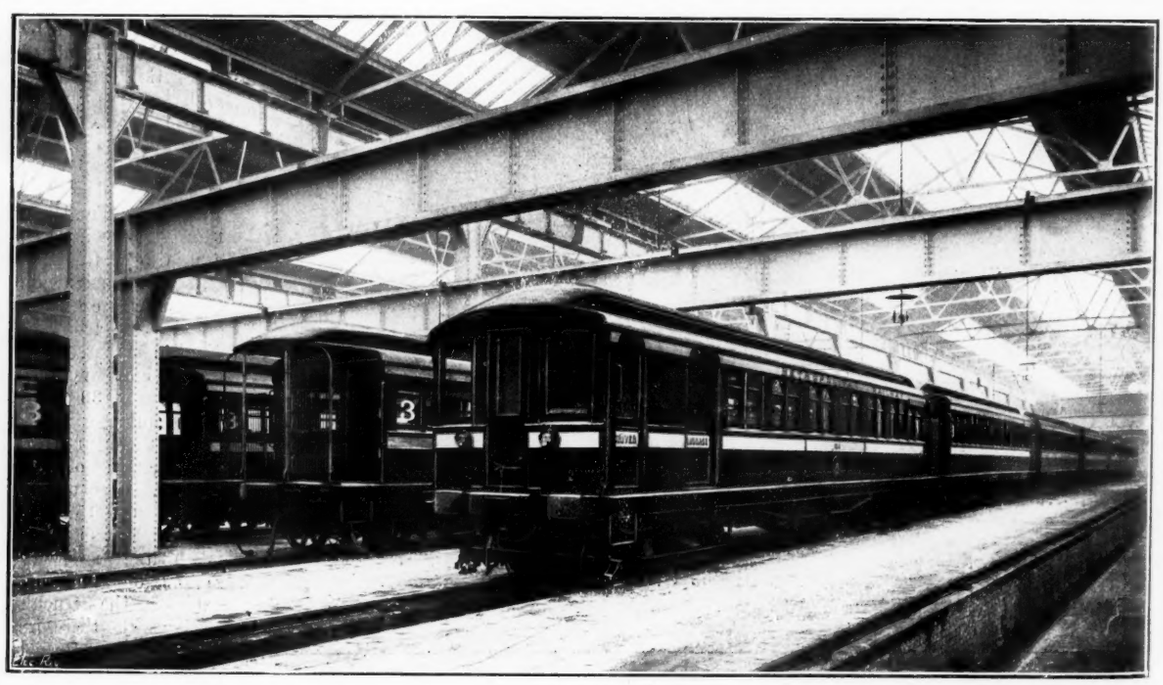
Interior of Electric Train.

All the electric trains on the Metropolitan Railway will be operated by means of the Westinghouse unit switch system of control, a full illustrated description of which appeared in our issue of July 29th, 1904, Vol. 55, pp. 179—182. It consists essentially of two parts, the pneumatic turret controller carried under the body of the motor-car, and the master controller placed in the driver's cab.

The master controller is remarkable for its small size and compactness. It operates the air-valves of the turret controller by aid of a 14-volt current taken from a small storage battery on the car. It has five notches for both forward and backward running, in addition to the "off" or neutral point. The movement of the controller handle to the first stop sets the emergency brake valve; the second sets the reverser—a piece of apparatus for controlling the direction in which the car is run — and puts on the main supply current; the third, or shunting notch, connects the motors in series with all resistance in; the fourth brings the automatic accelerator into play, which closes the switches of the turret controller in their right order, unless checked by what is termed the limit switch; and the fifth, opening all the pneumatic switches that have been closed, and simultaneously throwing in others, connects the motors in the first parallel stage with resistance in circuit.

The limit switch accelerator, which is a very important part of the apparatus, automatically closes the turret controller switches one after the other up to the eighth resistance, or last series point. After the movement of the master controller to the fifth notch has effected the change from series to parallel, the automatic accelerator again comes into play and limits the rate at which the necessary changes in connections are made to attain full speed.

The overload and no-voltage return relay is in electrical



Electric Train in Car-shed at Neasden.

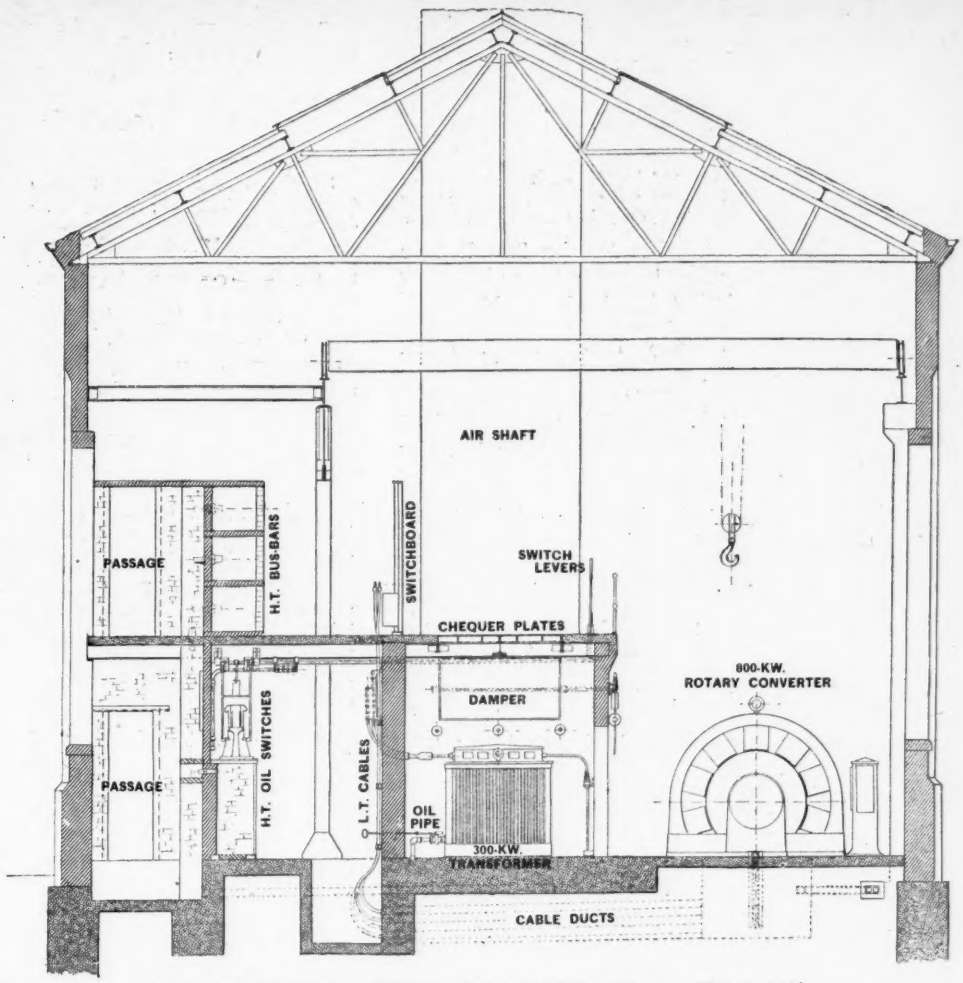
connection with the actuating magnet of one of the pneumatic cylinders of the turret controller which operates the main circuit-breaker. To prevent damage from a resumption of supply after any interruption, such as a break in the third rail or persistent bad contact in the collecting shoes, the no-voltage part of this device returns the controller to a position in which some considerable amount of resistance is in circuit, allowing it to be gradually and automatically cut out when the current comes on again. Sudden interruptions and resumption of supply, such as occur when the collectors pass over points or crossings, do not affect the relay, it being arranged to work too slowly for this.

Three of the most important points in the control equipment of these cars are as follows. The possibility has been recognised that through accident or sudden illness the driver may let go the controller handle, in which case, especially under the latter circumstance, grave consequences may ensue. This is provided for by means of a strong spring action, which, when the handle is released, returns it to the neutral position, interrupting in passing the circuit of an electro-magnet attached to the air-brake. This opens a valve in the main pipe of the system, allowing the air to escape, and the brakes to be immediately applied over the full length of the train. In the ordinary reversing of the train, this arrangement does not operate, provided the handle is passed quickly over the neutral point.

The second safeguard is that which prevents any harm being done to the motors if the operator moves the controller handle rapidly over to the full parallel position. In such a case, the speed of working of the turret controller does not increase, and the various connections passing from first series to full parallel are made automatically at the right pace. This reduction of the human element to a very low value results not only in greater safety and comfort to passengers, but in considerable economy in power consumption, amounting to as much as 10 or 15 per cent. over that obtained by ordinary hand operated methods.

The third provision is a system of interlocking between the control equipment and the power brakes, whereby the controllers throughout the entire train are opened automatically when the brakes are applied, no matter in what position the driver may hold the master switch handle.

A very fine car-shed has been built by the company at Neasden, and is partly seen in the view on p. 146. In conclusion, we have pleasure in acknowledging our indebtedness to Mr. A. C. Ellis, general manager of the Metropolitan Railway, for affording us facilities to visit the power station and sub-stations, and to obtain photographs. The chief electrical engineer is Mr. C. Jones, and the consulting electrical engineer is Mr. Thomas Parker.



METROPOLITAN RAILWAY: VERTICAL SECTION OF SUB-STATION. (See p. 144.)

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 142.)

Telegraphic Interruptions and Repairs :—

CABLES.	INTERRUPTED.	REPAIRED.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 19, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 23, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostok-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chifu	Mar. 9, 1304	
Paramaribo-Cayenne	July 13, 1904	
Sitka-Valdez	Nov. 11, 1904	
Cape Haiti-Puerto Plata	Dec. 25, 1904	Dec. 29.
Jamaica-Colon	Jan. 5, 1905	
Indo-European (Lowestoft-Emden)	Jan. 20, 1905	Jan. 20.
LANDLINES.		
Cartagena-Baranquilla	Dec. 8, 1900	
Puerto-Barrios	July 28, 1902	
Kertch-Soutchoum	Sept. 27, 1904	
Bhamo route beyond Tali	Jan. 15, 1905	
Rome-Pera	Jan. 16, 1905	Jan. 21.
via Batoum-Elarich-Fao-Hanekin	Jan. 16, 1905	

Telephones and Rural Disfigurement. — Lord Stanley, the Postmaster-General, was, on Thursday, to receive a deputation on the subject of the disfigurement of commons, open spaces, and places of natural beauty by the erection of lines of posts and wires.

Wireless Telegraphy. — The U.S. Government has ordered that noon time signals are to be sent from the Brooklyn Navy Yard by wireless telegraphy to ships at sea.

Lieut. Peary anticipates being able to keep in touch with civilisation during his coming voyage to the North Pole by means of a number of wireless stations to be established at suitable points along his route.

Wireless telegraph communication on the Telefunken system will shortly be established, says the *Standard*, between Berlin and Vienna by the German Wireless Telegraphy Co.

Our New York correspondent says that a suit is pending between the Marconi and De Forest Wireless Telegraph Companies as to alleged infringements of patents by the latter company. Demonstrations of wireless telegraphy have been given in court before Judge Townsend.

CONTRACTS OPEN AND CLOSED.

OPEN.

Australia.—February 7th. Tenders will be received at the office of the Deputy Postmaster-General, Melbourne, for (1) 3,500 trunk line multiple jacks, in strips of 20; (2) 1,320 yards of 64 wire wool insulated switchboard cable. Specifications at the General Post Offices at Melbourne, Sydney, Brisbane, and Adelaide.

Austria.—January 31st. The Austrian State Railway Authorities in Prague are inviting tenders until the 31st inst. for an installation of electric lighting in the buildings at the Prague Railway Station.

Barking Town.—February 10th. Boiler, pump, 400-KW. steam dynamo, switchboard panels, crane, &c., for the U.D.C. See "Official Notices" to-day.

Belgium.—February 8th. The Belgian State Railway Authorities at La Bourse, Brussels, are inviting tenders until February 8th for the establishment of a central electric lighting station at the new goods station near the Brussels Dock.

Belgium.—February 13th. Tenders are being invited until February 13th by the Municipal Authorities of Ghent for the supply of 15 electric cranes for use in connection with the docks. Tenders are to be sent to l'Hotel de Ville, Ghent, whence particulars may be obtained.

Belgium.—February 16th. Tenders are being invited until February 18th by the municipal authorities of Saventhem for the establishment of a central electric lighting station in the town. Tenders are to be sent to Le College des Bourgmestre et Echerins, Saventhem, Belgium, whence particulars may be obtained for 4 fr.

Bermondsey.—February 6th. Arc lamp carbons, meters, oils, cables, conduits, &c., for one year, for the electricity and destructor works. See "Official Notices" to-day.

Bury.—February 14th. One 500-KW. direct-current high speed generating plant, for extensions. See "Official Notices" to-day.

Drax.—January 28th. Schemes for electric lighting and electric pumping at Read's Grammar School, Drax, near Selby, are invited. Apply Head Master, Mr. W. St. G. Drennan, at the School.

Germany.—January 31st. Tenders are being invited by the Prussian State Railway Authorities in Cologne for the supply of 449 tons of galvanised iron wire, 94 tons of bronze wire, and 126,900 porcelain insulators. Tenders are to be sent to Die Konigliche Eisenbahn Direction, Cologne, whence particulars may be obtained.

Halifax.—January 31st. Coal conveyor, shutes, &c., for the electric light and tramway power works. See "Official Notices" January 6th.

Hammersmith.—February 8th. Stores—arc lamp accessories, globes, carbons, commutator brushes, incandescent lamps, oil, meters, &c. See "Official Notices" to-day.

Handsworth.—February 2nd.—The U.D.C. is inviting tenders for power and lighting circuits and fittings in the generating station; pipework, feed-pumps, economiser, electricity meters. See "Official Notices" January 13th.

Ilford.—February 7th. Concentric armoured cable for the Council. See "Official Notices" to-day.

Johannesburg.—March 6th. 100 electric cars, two electric water cars, five-ton crane, car traverser, and workshop tools, for the Municipal Council. See "Official Notices" December 30th.

Keighley.—January 30th. Cars for the Corporation. See "Official Notices" January 20th.

Leek.—February 20th. Wiring and fitting the Town Hall for the U.D.C. See "Official Notices" to-day.

Leith.—February 15th. One 600-KW. steam dynamo, water-tube boiler, and traction switchboard for the Corporation. See "Official Notices" to-day.

Oulton Broad.—February 4th. Public street lighting proposals are invited by the U.D.C. See "Official Notices" January 20th.

Porto (Portugal).—March 15th. The Town Council has opened a competition for the concession of the exclusive right of the working of the tramways for collective transports of passengers, luggage, and goods in all the municipal public ways. The conditions of the competition are published at the Portuguese Consulate in London.

Shanghai.—March 31st. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

South Shields.—February 20th. Permanent way and construction of track; rail bonds and bonding; conduits, cables, and overhead equipment for the Corporation. See "Official Notices" January 13th.

Stockport.—February 1st. Ten complete feeder pillar boxes with bases. See "Official Notices" January 20th.

Stockport.—February 6th. Overhead equipment of four miles of tramway; copper bonds. See "Official Notices" January 20th.

Stockport. February 15th. — One 21-KW. tramway booster. See "Official Notices" to-day.

Todmorden.—Electricity meters for the Corporation. See "Official Notices" to-day.

West Ham.—February 9th. Engine room and electrical stores for the Council. See "Official Notices" January 20th.

CLOSED.

Belfast and Leith.—The Forest City Electric Co., of Manchester, has obtained the orders for "Protected" rail bonds for the Leith and Belfast Corporation Tramways.

Belgium.—The Allgemeine Electricitäts Gesellschaft submitted the lowest tender for the supply and laying of the electric lighting mains in Charleroi. The tender of the Ateliers Electriques de Charleroi was £1,240 higher, but as it is stated that the offer of the German firm does not include the whole of the work, the quotation of the home company is said to show an advantage of £160.

Dover.—The T.C. has accepted the tender of the British Electric Equipment Co., Ltd., for the construction of the permanent way, overhead equipment, and laying of feeder cables in connection with the Dover and River Light Railways.

Erith.—The U.D.C. has accepted the tender of the British Westinghouse Co., Ltd., for the supply of tramcar brakes at £700, and that of Messrs. John Hitchin & Son, Ltd., for the construction of mechanically-operated gates at the West Street tramway crossing, at £290 10s.

The following tenders were received for the supply of 14 tramcars, seven top-deck covers, the cars to consist of Brush bodies, Mountain & Gibson trucks, and also for a track sweeping and watering car:—

	Tramcars.	Track sweeper, &c.
British Westinghouse Co. (accepted) ..	£8,522	£626
Mountain & Gibson	—	650
British Thomson-Houston Co.	8,189	608
Dick, Kerr & Co., Ltd.	8,935	668
Hurst, Nelson & Co.	7,528	658
Brush Electrical Engineering Co.	8,278	680
St. Louis Car Co.	9,279	—
Witting, Eborall & Co.	7,682	573

Glasgow.—The Tramways Committee has recommended that the offers of the British Westinghouse Electric and Manufacturing Co., Ltd., for (1) the supply of motor equipments and spare parts for 100 electric tramcars, and (2) 100 sets of Newell magnetic brakes be accepted.

Messrs. Fletcher, Kilpatrick & Co. have received the contract for the electric lighting of Bridgeton District Library, at £288.

The contract for the steel work required in connection with the switchboard gallery in the extended portion of the Port Dundas generating station has been secured by Messrs. Redpath, Brown and Co. The amount is £105 10s.

London.—The Metropolitan Asylums Board received the following tenders on Saturday for the installation of electric light, telephones and fire alarms in Belmont Asylum:—

Bromley & Batstone (accepted), £2,244, made up thus: electric light, £1,995; telephones, £250; fire alarms, £69.
F. A. Glover & Co., Ltd., £2,483 10s.
Belshaw & Co., £2,660.
Buchanan & Curwen, £2,675
Wenham & Waters, Ltd., £3,806
Bergtheil & Young, Ltd., £3,176 10s.

The estimate of the Board's engineer-in-chief was £2,450.

For extending the internal telephones at the North-Western Hospital:—

J. W. Gray & Son (accepted)	£126 0 0
Private Wire & Telephone Installation Co., Ltd. ..	140 0 0
New System Private Telephone Co., Ltd.	160 13 4
A. N. Gifkins & Co.	162 0 0
Buchanan & Curwen	168 0 0
J. Richmond & Co.	258 10 0

London.—The Highways Committee of the London County Council has accepted the tender of Mr. W. Harbrow, amounting to £1,437, for the erection of the temporary end screen required for the first portion of the power station at Greenwich. Three other tenders were received for the execution of the work.

West Australia.—The *Australian Mining Standard* says that in connection with the Fremantle (W.A.) electric tramway, Messrs. Noyes Bros., electrical engineers, have informed the board that orders for machinery have been placed as follows:—Four

engines, Belliss & Morcom, Birmingham; 14 cars, Brill, Philadelphia; cables, trolley wire and bonds, J. G. White, London; generator, motors, meters, lamps, transformers, switchboards, Westinghouse Co., Manchester. Messrs. J. G. White & Co. had placed the order for the rails with the United States Steel Products Export Co. The total price was £4,908 15s.

Whitechapel.—The Guardians received 21 tenders for the installation of the electric light in Section 2 of the Infirmary, as follows:—

Foote & Milne	£259	0	0
Scott-Anderson, Sheffield	360	0	0
Edwards & Armstrong, Bristol.	268	0	0
Cunningham & Co., Edgware Road (*accepted*).	175	0	0
Sweet Bros., Hampstead Road.	203	0	0
Pal & Co.	250	0	0
Lawrence, Ld., Leicester Square, W.C.	320	0	0
Strange & Sons, Tonbridge, Kent.	323	18	0
H. Downer	355	0	0
G. & H. Turner ..	320	0	0
Lea & Sons, Shrewsbury	£226	0	0
Taylor & Co., Cannon Street, E.C.	304	0	0
A. H. Marshall & Co., Leytonstone.	420	0	0
A. H. Woods, Westminster	245	0	0
Thos. Potter & Sons ..	269	0	0
Smeeton & Page ..	296	15	0
Defries & Sons.. ..	252	10	0
Vere & Co.	409	10	6
Jackson Bros., Plaistow	274	18	0
J. O'Grant	279	0	0
Assersoling, Commercial Street, E.	225	0	0

FORTHCOMING EVENTS.

To-day's Arrangements.—At 5 p.m. Physical Society. "Action of a Magnetic Field on the Discharge through a Gas," by Dr. R. S. Willows. (2) "Action of Radium on the Electric Spark," by Dr. R. S. Willows and Mr. S. Peck.

Automobile Show at Crystal Palace. Opening day; closing on February 4th.

Saturday, January 28th.—At 3 p.m. I.E.E. (Students). Visit to the G.P.O. Central Telephone Exchange.

Monday, January 30th.—At 8 p.m. Faraday Society. "Mass Analyses of Muntz's Metal by Electrolysis, and Some Notes on the Electrolytic Properties of this Alloy." By Mr. John G. A. Rhodin, F.I.C.

Tuesday, January 31st.—At 7.30 p.m. I.E.E. (Manchester). Messrs. L. B. Atkinson and C. J. Beaver on "Some Points on the Selection of Electric Cables."

Wednesday, February 1st.—At 7.30 p.m. I.E.E. (Students). "The Present Electrical Equipment of the L.C.C. Tramways," by Mr. J. W. Anson.

At 8 p.m. Society of Arts. "The Navigation of the Nile," by Sir Wm. H. Preece, K.C.B., F.R.S.

At 2.30 p.m. Institution of Civil Engineers (Students). Visit to the National Physical Laboratory, Teddington.

Thursday, February 2nd.—At 8.15 p.m. Röntgen Society. "Some Points in the Construction of a High Frequency Machine," by Dr. Clarence A. Wright.

Friday, February 3rd.—At 7.30 p.m. I.E.E. (Manchester Students). "The Electric Equipment of Automobiles," by Mr. V. H. Mahler.

At 8 p.m. Junior Institution of Engineers. "Recent Developments in Electric Lighting," by Prof. H. T. Davidge.

Saturday, February 4th.—At 7.30 p.m. I.E.E. (Glasgow). Annual Smoking Concert at the Grosvenor Restaurant, Gordon Street.

Saturday, February 11th.—At 6.30 for 7 p.m. Junior Institution of Engineers. Coming-of-Age Dinner of the Institution at the Hotel Cecil.

THE ELECTRICAL VOLUNTEERS.

THE following orders are announced for next week:—

Monday, January 30.—"A" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture by Mr. Frank B. Aspinall, M.I.E.E., on "Jointing," with practical demonstrations, 8 p.m.

Tuesday, January 31.—"B" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Medical inspection for recruits and Special Service Section, 7 p.m.

Wednesday, February 1.—Instructional drill, headquarters, 8 p.m.; plain clothes; rifles without slings. Submarine mining class, 6–9 p.m. Examination "C" and "D" Companies for "A" badge, 8 p.m.

Thursday, February 2.—"C" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture by 2/Corp. E. C. Smith on "Electric Lighting Meters," 8.30 p.m.

Friday, February 3.—"D" Company. Recruits' drill, 6 p.m.; technical instruction, 7 p.m. Lecture on "Portable Field Engine and Search Lights," by Capt. Phillips.

Saturday, February 4.—Week-end class.

J. H. S. PHILLIPS, Captain,
For O.C.E.E.R.E. (V.)

NOTES.

Association of Engineers-in-Charge.—At a recent meeting of this association, a paper was read by Mr. Horace Allen on "Gas Producer Plant and Gas Engines," Mr. Ardley presiding. The lecturer, after briefly enumerating and commenting upon other types of gas generator, dealt with the suction gas producer in detail. As an arbitrary basis of comparison, he took the ratio of the thermal value of the carbon in the gas to that of the carbon consumed; this ratio in the case of air-gas was 73 per cent., and the volume of gas evolved was 89 cb. ft. per lb. of carbon consumed, having a calorific value of 119 B.Th.U. per cb. ft. The temperature of the issuing gas in this case was excessive. Dowson gas gave an output of 93 cb. ft. per lb., containing 158 B.Th.U. per cb. ft., and having a thermal efficiency of 89 per cent. The suction gas producer gave 110 cb. ft. per lb. of carbon, having a calorific value of 127 B.Th.U., and a thermal efficiency of 96·7 per cent., while the temperature of the gas was comparatively low.

The results of 8-hour tests of a Paxman suction gas producer and 20-B.H.P. engine, designed by Mr. W. W. Judd, were given; the complete plant occupied a floor space of 22 ft. × 11½ ft. Practically no attention was required by the producer during the tests, beyond occasional recharging, and there was no premature ignition, backfiring or misfires. With coal at 22s. per ton, the cost of fuel per B.H.P.-hour was 0·11d., as compared with 0·21d. for Mond gas at 2d. per 1,000 cb. ft. The engine was fitted with a patent graduated governor and a patent magneto-ignition device, which would work satisfactorily at as low a speed as 1 r.p.m. The details of one of the full-load tests were as follows:—Speed, 223 r.p.m.; mean effective pressure, 62 lb.; net coal used, 1·04 lb. per B.H.P.-hour (anthracite peas with 5½ per cent. ash); thermal value of gas, 128·7 B.Th.U. per cb. ft.; thermal efficiency, 96·8 per cent.; mean initial pressure, 310 lb. per sq. in.; suction, 2 in. of water. No clinker was formed.

A brief discussion followed the paper. The chairman, Mr. Ardley, and Mr. W. H. Booth asked questions relating to the deposit in the cylinder, pre-ignition, the temperature of the gas, &c., and Mr. F. Broadbent asked as to the behaviour of the producer and engine when subjected to widely varying loads, short stoppages, &c. In reply, Mr. Allen said that rich gas, such as illuminating gas, was more liable to pre-ignition than producer gas, and the latter could, therefore, be given higher compression with advantage. No pre-ignition occurred during the tests. The temperature of the gas entering the scrubber was 360° F.; leaving the scrubber it was quite cool. The quality of the gas did not vary with the load, and the producer immediately responded to variations in the demand. No trouble was met with in changing from light to full load. Clinkering could be avoided, on long runs, by using pure coal.

The proceedings ended with a vote of thanks to the lecturer.

The Cooper-Hewitt Lamp.—Mr. P. Cooper-Hewitt seeks leave to amend the specification granted to him in 1900 for "improvements in and relating to electric lamps."

Hurricane Danger Signal.—To guard against accidents on the well-known Levens viaduct, the Furness Railway Co. has erected an ingenious automatic signalling apparatus. According to the *Yorkshire Post*, it consists of a combined wind pressure gauge and recorder, and is connected with an electric arrangement by means of which bells are set ringing in distant signal cabins. These bells will continue to ring so long as the velocity of the wind on the viaduct is dangerous to passing trains, and consequently all traffic will be stopped. A mail train was blown over on this viaduct during a gale in February, 1903.

Electrical Fires in New York.—The report of the Fire Department for the year 1903, just issued, shows that there were 83 fires originating from defective electric fixtures, involving a loss of $47,751, out of a total number of 6,787 fires and a total property loss of $4,246,260. There were also 211 recorded cases of ignition on electric street cars, involving a loss of $3,798.

Claim Regarding an Electrocuted Dog.—An action was concluded in the Sheffield County Court on 20th inst., in which Joseph Rodgers, labourer, sued the manager of the Zeala Meat Co.'s shop, at Crooks, for £5, the value of a dog. On November 2nd the dog entered the shop and stole a rabbit and two pieces of meat. Johnson, the manager, embedded the live electric wires in a piece of meat and put it on the floor. The dog went for it and was electrocuted on the spot. Johnson said he only intended to give the dog a shock. The Judge, according to the *Morning Post*, held that Johnson placed the wires in the meat at his peril, and he was liable for the consequences. Judgement for £3 and costs.

London County Council.—At the meeting on Tuesday the Council decided to sanction the borrowing by the St. Pancras Borough Council of £5,370 for electric lighting works and meters, and to advance £10,000 to the Stepney Council for electric lighting purposes.

The Highways Committee reported that the Board of Trade had approved the system of traction proposed to be introduced on the northern tramways, providing for the use of a conduit slot not exceeding 1 in. in width. The lines in question comprise about 22 miles of single line, now leased to the North Metropolitan Tramway Co. The Committee asked the Council to approve an additional expenditure of £5,000 incurred in connection with the contract entered into in 1903, with Reid Bros., for the laying of the ducts for the cables required for the working of the New Cross and Greenwich sections of the tramways. The extra outlay was due to the laying, in certain instances, of the ducts under the carriageways instead of under the footpaths, to the existence of numerous underground obstructions, and to the payment of district surveyor's fees in respect of certain draw-boxes.

Approval was given to plans submitted by the Baker Street and Waterloo Railway Co. for the erection of a transformer station with a frontage to London Road and St. George's Circus, by the Chelsea Supply Co. for the construction of a generating station on a site abutting on the southern side of Alpha Place and the eastern side of Manor Street, Chelsea, and by the South London Co. for the building of a transformer station at the Loughborough works.

St. Petersburg.—It is reported that the Westinghouse works at St. Petersburg have been temporarily closed to avoid the possibility of trouble. Only 400 men were engaged at the works.

It is stated that many quarters of the city are in darkness in consequence of the strike of employés of electric lighting undertakings.

Papers and Lectures.—At the Royal Institution on Friday Sir James Dewar delivered a discourse on "New Low Temperature Phenomena."

Mr. Bradley, engineer to the City of Westminster, lectured to the members of the Westminster Debating Society in the Caxton Hall recently on the dispersal of fog. He said that he had accepted an invitation from Sir Oliver Lodge to view his electrical installation for fog dispersal at Birmingham, and engineers of several electric lighting companies had also promised to be present.

On Sunday, January 22nd, under the auspices of the Leeds Sunday Lecture Society, a lecture was delivered by Mr. Richard Kerr, F.G.S., F.R.A.S., on "Wireless Telegraphy."

Before the Royal Scottish Society of Arts on 16th inst. a paper was read on "Electric Lifting Machinery," by Mr. John Ritchie, of Carrick & Ritchie.

A course of lectures is being given at the Mechanics' Institute, Bradford, by Dr. Alfred H. Fison, on "Light and its Relation to Electricity." It is in continuation of the series which the same lecturer delivered three years ago upon electricity.

At a meeting of the Glasgow Technical College Scientific Society held on Saturday evening under the chairmanship of Mr. R. D. Munro, M.I.Mech.E., Mr. Maurice George, B.Sc., read a paper on "The Electrical Drive of Large Reversing Engines Working Intermittently."

At a meeting of the Edinburgh Architectural Association last week, Mr. Mathew Buchan read a paper on "The Electric Lighting of a Country House."

A meeting of the South Wales Institute of Engineers, held at Cardiff last week, resumed consideration of the two following papers, "Notes on Some Examples of Electrical Winding Engines" (by Mr. Graham M. Stevenson) and "Coal-Winding Machinery" (by Mr. H. D. B. How).

The Institution of Electrical Engineers last night discussed the paper on "Fuel Economy in Steam Power Plants," by Messrs. W. H. Booth and J. B. C. Kershaw.

Electric Shock Fatality.—A clock-winder at the Leeds New Market Hall received a shock in the clock tower on January 6th which ended fatally. The jury at the inquest held last week found that death was "accidentally caused by an electric shock," and they added certain recommendations regarding lower voltage being desirable, and the need for rendering the winding-up part of the clock more easily accessible. It seems that the deceased man had often complained of receiving shocks. Mr. T. Harding Churton, who made an expert examination of the clock at the coroner's request, said that alternating current at 200 volts pressure was taken from the electric lighting mains to operate an electric gong in connection with the clock. The arrangement was such that the clockwork itself was electrified at intervals, and a shock from the full force of the supply would then be sustained by anyone touching the clockwork and the iron structure of the tower simultaneously, unless the switches in the base of the tower were turned off, in which case there would be no danger of shock. If, however, the switches were left turned on, it would be difficult in so small a space to attend to the clock without receiving a shock. He suggested that either the clock should be insulated from the electric wires and earthed, or the voltage of the current should be reduced so as to render a shock harmless. The effect of a 200-volt shock depended upon the state of health of the person receiving the shock, and the length of time that it was sustained. Under ordinary circumstances, there would be no danger from a momentary shock of such a voltage. Dr. Collinson, from the General Infirmary, agreed with the latter statement, but he believed that in the case of Baskerville, who suffered from a weak heart, such a voltage passing through his body might cause death. It was stated that the deceased had been cautioned to switch off the current when he entered the tower.

Engineering Standards Committee.—Mr. Leslie S. Robertson, secretary to the Committee, sends us the British standard specification for Portland cement, which has been drawn up by an exceptionally strong committee, and is regarded as one of the most important specifications yet issued. The directions for the manufacture, composition, and testing of the cement are minute and comprehensive, and drawings of the essential parts of the apparatus for testing the tensile strength, setting time and expansion of the samples are given.

Meeting of Electrical Workers.—A mass meeting of electrical workers and others is being called. It is to be held in the concert room, White Hart Hotel, High Street, Acton, W., on Thursday, February 2nd, 1905, at 8 p.m., and is to protest against the employment of cheap labour upon the electrification of the District and other underground railways of London. Mr. Jas. Macdonald, secretary of the London Trades Council, will occupy the chair.

Appointments Vacant.—Junior shift engineer for Dover (£80); assistant electrical engineer for West Bromwich (£120); ledger clerk (£100) and junior clerk (£50) for Marylebone Electricity Supply Committee; temporary draughtsman for the South Shields electrical department (£3).

Fire.—One of Wednesday morning's papers contained the following:—"The electric light generating station at Frant, on the Sussex side of Tunbridge Wells, caught fire yesterday, and the building, together with the costly plant, was entirely destroyed. The property was insured." We at once began to think of Mr. Boot and his municipal plant at Tunbridge Wells, but we were glad to learn over the telephone that it was not this system that the note referred to. Those who happen to have seen the original report will be pleased to receive this explanation. We find that the statement concerns one of the private installations in the neighbourhood.

Electrical Exhibitions.—The County of London Electric Supply Co. announces an electrical exhibition to be held in Holborn, W.C., from March 20th to April 5th. The Loughborough Corporation is also arranging to hold an electrical exhibition shortly. For further particulars see our advertisement pages to-day.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—The workmen of the Burgh of Partick Electricity Department have presented Mr. A. J. ABRAHAM with a leather suit case, and also a leather portmanteau, on the occasion of his resigning the post of chief assistant engineer.

The Dartford Urban Council, on Saturday, received a notice from the solicitors to Mr. WATERLAND, formerly their electrical engineer, that after the expiration of one month they would commence an action on behalf of Mr. Waterland against the Council in respect of his claim for doing the work of consulting engineer during the time he was employed as resident electrical engineer. The Council has decided to defend the action.

We regret to learn that Mr. BIRKETT, the Burnley borough electrical engineer, met with a serious accident on 20th inst. It appears that the staff at the works and the members of the Electricity Committee had assembled at the generating station to witness the trial of an electrically-driven air compressor. After this had been running on a wood floor for some time, an engine-driver and a switchboard attendant approached the machine to attach it to one of the generators; as soon as the former put his foot on the metal floor-plate he dropped violently to the ground. Mr. Birkett went to his assistance, and while so engaged his hands came in contact with the metal drawbar of the compressor, and he, too, was prostrated. Mr. Birkett was unable to loosen his hold of the drawbar, and he became unconscious. An assistant broke the circuit at the switchboard. The switchboard attendant and the engine-driver both received a severe shock, but Mr. Birkett was more seriously hurt. Holes were burnt through his clothes, and his knee was seriously injured in consequence of the violence with which he was flung down. The accident is attributed to an armoured tube attached to the compressor accidentally coming in contact with one of the terminals of the motor.

Tramway Officials.—Huddersfield T.C. has increased the salary of Mr. J. C. WHITELEY, chief assistant in the Tramways Department, from £150 to £160 per annum.

Last week we gave a list of the selected candidates for the post of general manager to the Newcastle-on-Tyne Tramways. On 20th inst. the Committee selected the following gentlemen from among those already mentioned:—Mr. G. Conaty, manager of the Birmingham Tramways; Mr. Ernest Hatton, manager of the Salford Tramways; Mr. C. W. Mallin, traffic superintendent at Liverpool; Mr. C. J. Spencer, manager of the Bradford Tramways; Mr. H. E. Yerbury, deputy manager of the Sheffield Tramways.

Mr. M. H. VOLK has resigned his position as works engineer to the Brighton Corporation Tramways Department, which position he has held for the last three years, to take up an appointment as engineer and manager to the Brighton Beach Electric Railway. On Friday last Mr. Volk was presented with a case of drawing instruments and a book on railway working. On making the presentation on behalf of the office staff, Mr. T. B. Holliday (tramways engineer and manager) expressed regret on losing Mr. Volk, but wished him every success in his new career. Mr. Volk was also the recipient of a walking stick from the works staff.

General.—Mr. R. H. T. DRUMMOND, A.M.I.E.E., some four years electrical engineer in the Madrid generating station belonging to the Electricity Supply Co. for Spain, and later constructing engineer in Estremadura, Spain, for the lighting of two towns, Don Benito and Villanueva de la Serena, has recently returned to England from Mexico, having disposed of his concession for lighting and power covering the towns of Monclova, Cuatro, Cienegas, Musquiz, and San Buenaventura, granted by the Federal Government of that Republic.

The second assistant Postmaster-General of the United States left New York for London on 21st inst. to confer with the officials of the British Post Office on matters connected with the International Postal Service.

Mr. JAMES C. INGLIS, general manager of the Great Western Railway, has been nominated by the Council of the Institution of Civil Engineers as one of their representatives on the Engineering Standards Committee, in the place of the late Mr. John Allen McDonald, engineer-in-chief of the Midland Railway.

On January 13th the Brighton Corporation Telephone Department celebrated the completion of its first year of life by an inaugural conversazione at the Old Ship Assembly Rooms, under the auspices of his Worship the Mayor (Mr. Alderman F. Blaker). Mr. D. J. Barnes, the manager of the telephone undertaking, with Mrs. Barnes, received the guests.

It is reported from New York that on 23rd inst. Mr. THOMAS A. EDISON was operated on for mastoiditis.

Mr. H. M. HOBART has been appointed Lecturer in Electrical Engineering Design at the Northampton Institute in succession to Mr. E. Kilburn Scott, who has been appointed Lecturer in Electrical Engineering in the University of Sydney. Mr. M. HOLROYD SMITH has been appointed Chief Assistant in the Mechanical Engineering Department in succession to Mr. W. E. Curnock, who has been appointed Head of the Mechanical Engineering Department of the Technical College, Huddersfield.

Obituary.—We regret to learn of the death, which occurred on 17th inst., of Mr. HENRY DE GRELLE-ROGIER, Belgian Vice-Consul, at his residence, Brant Lodge, Elsworthy Road, N.W., from pneumonia, after an illness of only a few days. The deceased gentleman was a partner in the firm of De Grelle, Houdret & Co., of 130, London Wall, E.C.

ELECTRIC TRAMWAY ACCOUNTS.

Bradford Corporation Tramways.

THE annual report of the Bradford Tramways Department for the past year discloses a further considerable extension of route mileage due partly to the acquisition, as a running concern, of the Mid-Yorkshire tramways by arrangement with that company and the Shipley U.D.C. A statement of the system, as at present, is as follows:—

	Miles.	Miles.
Owned by Corporation inside city ...	43	76·5
" " outside city ...	5·5	9·5
Leased from Shipley U.D.C.	4·5	9
Total length worked by Corporation	53 route	95 single track

The year's working does not disclose any great increase in passengers carried (the figures are approximate for both years), but an increased average income and gross revenue have been earned. The gross profit is some £3,500 in excess of the 1903 figures and suffices to give a balance of £13,400, after meeting statutory charges.

Due to recent increase in mileage, the Bradford tramways now come fourth in point of length of route in Great Britain, the population served is less than half that on the larger systems, and the routes, though shorter than, are usually in direct competition with existing railway routes; the earnings are, therefore, very satisfactory, and, excluding power costs, the figure for working expenditure is low.

That total expenses are higher, and the available profit margin lower, this year than previously will be readily appreciated, under the altered conditions. The balance of £13,400 was applied, as to £10,483, to cancelling the unexpired leases account, and, as to the remainder, to the depreciation and renewals account, which now stands at £28,057. Mr. C. J. Spencer is the tramways manager.

GENERAL STATEMENT.

For 12 months ending March 31st ...	1904.	1903.
Length of route	53 miles.	40 miles.
Total length of track	95 "	68 "
Number of cars in use	115	200
Car-miles run	4,546,942	4,013,191
Passengers carried per annum (approx)	43,452,104	41,000,000
Capital expended to date	£818,205	£750,000
Traffic receipts	£193,207	£170,115
Total "	£197,438	£173,534
Working expenses	£137,932	£117,496
Gross profit	£59,506	£56,038
Income per car-mile	10·42d.	10·37d.
Working expenses per car-mile ...	7·28d.	7·02d.
Interest and sinking fund per car-mile	2·43d.	2·16d.
Total expenses per car-mile	9·71d.	9·18d.
Profit or loss per car-mile	+·71d.	+1·19d.
Cost of energy per car-mile	1·78d.	1·61d.
Average fare per passenger	1·17d.	1d.
" " mile	·62d.	—
Revenue per mile of route	£3 725	£4,338
Expenditure per mile of route ...	£2,602	£2,937
Total units used	7,731,563	6,067,387
Units used per car-mile	1·7	1·5
Percentage of working ex'es to receipts	69·86	67·7

PROFIT STATEMENT, 1904.

Interest on loans	£21,989
Sinking fund	24,117
Balance on year's working	13,400
Gross profit	£59,506

CITY NOTES.

The Nernst Friction: Technical v. Financial Strength.

IT is, indeed, regrettable that so much internal strife should characterise the proceedings of the Nernst Electric Light, Ltd. The company's history, right from its initiation, has been a most unhappy one, but it was supposed that when the scheme for the reduction of capital was elaborated by the directors, and approved both by the shareholders and by the Court last year, the past would be considered buried, and that some progress would be made towards a certain degree of prosperity. Smoother waters, however, have not yet been reached.

The figures contained in the report presented at the meeting held on Monday last, show that the income from sales of lamps in the foreign territories for which alone the company has selling rights, and from royalties, is likely to be sufficient to allow of the declaration of a fair dividend on the reduced capital of £90,000. The past year has been to a large extent occupied with the details of the capitalisation rearrangements, and it is to be naturally supposed that this troublesome scheme having been safely steered through, the board and staff will have more time to devote to energetically pushing on with the actual trading operations of the company. But if there are dissensions on the board, it seems to us to be hopeless to look for satisfactory results. One of the directors, Mr. A. M. Oppenheimer, is not in accord with the three other members of the board, and he urges the adoption of a policy of retrenchment. One of his demands was for the reduction of his own and his co-directors' fees; but when it was announced that the board would accept £500 per annum or any figure that the shareholders might suggest, his objections were apparently still unsatisfied. He asked that Sir H. Seton-Karr, M.P., be invited to join the board in place of Mr. R. J. Wallis-Jones, M.I.E.E., the director who in the ordinary course came up for re-election this year. He was careful to point out that it was not from any personal objection to Mr. Wallis-Jones that he took the present step; it was mainly to bring Sir Henry on to the board, as he was pledged to the policy of retrenchment, which he (Mr. Oppenheimer) desired. Messrs. Drake and Dalzell announced their intention to stand by Mr. Wallis-Jones, and said that if he were not re-elected they would resign. Now, if that had been the course permitted by the meeting, what would it have meant? There would have been no technical director. Mr. Wallis-Jones's qualifications as an electrical engineer, and Mr. Drake's close connection with the technical development of the lamp all the way along, can hardly be reasonably dispensed with in order that the control of this, a highly technical and scientific business, may be handed over to the tender mercies of solicitors or barristers, whose policy of retrenchment *may* be such as to injure it rather than help toward greater profit-earning. As to what the actual differences between Mr. Oppenheimer and Mr. Drake may be we know but little, but it did not seem to us from the attitude of Mr. Oppenheimer that there was any probability of these being amicably settled. What, therefore, is to be the next step? Mr. Oppenheimer and his adherents struggled hard to press the election of Sir H. Seton-Karr to a decision, but weighty words of counsel came from Sir Henry Mance and other calmer spirits in the meeting, urging that the welfare of the company should not be sacrificed by weakening the technical side of the undertaking, and placing upon the board a gentleman who was already connected with a large number of companies (the "Directory of Directors" gives Sir H. Seton-Karr as chairman of eight companies—none of which is electrical). Too many companies have fallen on evil days for want of adequate technical ability in their control, and apart from all other points, and whoever may be at the bottom of these ever-recurring periods of friction, we think that the Nernst Co. cannot afford to commit this error. To Mr. Oppenheimer and his friends, the chairman's exercise of his right to accept the adjournment of the meeting for a month was, no doubt, particularly galling, because they were strong in the strength of proxies, whereas Mr. Drake and his party were in the position of having a large number of proxies which arrived defective, or too late to be legally used. Mr. Drake was perfectly frank with the meeting in stating why he wished for an adjournment. In a month's time the necessary proxies will be in the board's possession, and the danger of the substitution of financial for technical directors will be averted. That fact alone seems to us ample justification for the course adopted. But if Mr. Wallis-Jones be re-elected at the adjourned meeting—as we are convinced he ought to, and believe he will, be—there may not be an end to the present

difficulties. Discord may still remain; but, perhaps, if Mr. Oppenheimer continues to advocate his policy of retrenchment, he may, if necessary, be able to bring some influence to bear upon his co-directors, though the actual voting may be three to one.

Eastern Telegraph Co.

THE report for the half-year ended September 30th, states that the revenue amounted to £589,386, from which is deducted £178,269 for the ordinary expenses, and £41,847 for expenditure relating to maintenance of cables, depreciation of spare cable, sundry differences in exchange, and income-tax payable abroad, leaving a balance of £369,268, to which is added £1,233 brought forward, making a total available balance of £370,502. After providing for income-tax payable in England, interest on loan from Eastern and South African Telegraph Co., Ltd., interest on mortgage debenture stock, and for two quarterly dividends on the preference stock, which in all absorb £97,870, there remains a balance of £272,631, out of which the directors have placed £12,000 to the reserve fund for maintenance of ships, £125,000 to the general reserve fund, and allocated £100,000 to meet the two interim dividends of 1¼ per cent. each on the ordinary stock, the balance of £35,631 being carried forward.

The half-yearly meeting was held on Wednesday at River Plate House, Sir John Wolfe Barry presiding.

The CHAIRMAN, in proposing the adoption of the report, said that the result of the half-year's working up to September 30th last would, he thought, be considered satisfactory. The gross revenue for the half-year had amounted to £589,386, against £565,703 for the corresponding period in 1903, or an increase of £23,683. Various branches of the traffic, notably that with India, showed a satisfactory increase. The South African traffic, however, showed a considerable decrease, and in consequence of the cessation of the Somaliland disturbances, the traffic with Aden had also decreased. In comparing the message receipts for the two half-years, it must be borne in mind that considerable reductions in the rates came into force on July 1st, 1903; the reductions affected the revenue for the whole of this half-year, while the corresponding period was only partially influenced by these alterations in the tariffs. The dividends received on their holdings in other telegraph companies were rather more this half-year, so that their gross revenue showed a gratifying increase of some £24,000. The total expenses for the half-year showed a small increase of £3,881, as compared with the corresponding period of 1903. The expenses in London were practically the same as the corresponding half-year. At the stations the net increase was about £8,500, the bulk of which was under the headings of salaries and wages, and was due to the usual annual promotions and an increase of 56 in the number of staff at their stations in England and abroad. As he had stated before, the policy of the directors of reducing rates whenever the circumstances warranted such an alteration in the tariff, must have the effect of increasing the working expenses, because in order to deal efficiently with the greater volume of traffic which usually followed a reduction in rates, the staff must be somewhat increased. It should not be forgotten that, whereas on a reduction of tariff it was necessary to increase the staff at once, it might take a long time to develop the same amount of revenue as that which existed prior to the reduction in the rates. During the last three years there had been a considerable increase in the number of words carried, the number of paying words alone dealt with during 1904 being over 4 millions in excess of those of 1901, but owing to the reduction in the rates, the receipts from messages were actually less than they were in 1901. The only other important increase was under the heading of maintenance of instruments, and was due to the adoption of improved methods and apparatus to improve the speed and accuracy of the service. The expenses attending maintenance of cables showed a decrease of about £4,000. They had had to carry out extensive repairs in connection with their own cables, but as their ships had been employed to effect considerable repairs for other companies, the expenditure chargeable to their own revenue account was substantially reduced. There was a large increase in the charge for income-tax which was owing to the authorities having re-considered the question of the allowance to be made for depreciation in respect of cables and other plant. A very large, and as they thought an improper, reduction had been made in the allowance, but the commissioners had agreed to state a case in order to get the ruling of the court as to what was a fair allowance for depreciation. Meanwhile they had had to pay the increased charge pending the decision, which he trusted would be in their favour. The net result of the half-year's working was that they were able to transfer the satisfactory amounts of £125,000 to the general reserve fund, and £12,000 to the maintenance of ships' reserve fund, and to carry forward a balance slightly in excess of the corresponding half-year of 1903. They had charged against general fund £113,100 in respect of new cables, and had repaid a further £100,000 to the Eastern and South African Telelegraph Co. on account of the loan made to them in connection with the cables forming the new route to South Africa and Australia. Some changes had been made in the constitution of their repairing fleet during the half-year. Being in need of a steamer of larger carrying capacity, they had acquired the ss. *Britannia*, which had already done some very useful work. The ss. *Mirror* had been disposed of to the Western Telegraph Co., as that vessel was specially adapted to their requirements. In conclusion, the Chairman referred with regret to the retirement of Mr. H. A. C. Saunders, who, he said, had been electrician-in-chief to the Eastern and associated companies since their formation. Mr. Saunders's association with marine telegraphy dated back 50 years, he having been employed in connection with the laying of the first successful Atlantic cable. He was pleased to say that Mr. Saunders had consented to accept the position of consulting electrician, so that his experience would still be available for the benefit of the companies.

Sir JOHN DENISON PENDER seconded the motion, and the report was adopted.

City of London Electric Lighting Co.

AN extraordinary general meeting of this company was held on Thursday last week at Salisbury House, E.C., to consider, and if thought fit, pass the following resolution:—"Resolved that the company approves the Bill proposed to be introduced into Parliament intituled 'A Bill for conferring further powers on the City of London Electric Lighting Co., Ltd., for the supply of electrical energy and for other purposes' subject to such additions, alterations and variations as Parliament may think fit to make therein."

Mr. GEO. HEBBING (chairman), who presided, said the object of the Bill was to supply electric energy to authorised undertakers or to persons requiring a supply for power purposes in an area comprising the whole of the Administrative County of London on the south side of the Thames and a large part of the northern side of the County of Kent. If the Bill passed it would be a very good thing for the company. He formally moved the resolution.

Mr. F. W. REYNOLDS seconded the motion.

Mr. REYNELL said it looked as if they were going very far afield. The Medway seemed a long way off. Could they not confine their business to closer quarters? He supposed the idea was to supply power all along the banks of the Thames.

The CHAIRMAN said that was so. Of course they might not get the whole of the district asked for.

Mr. REYNELL asked how the business generally was going.

The CHAIRMAN said seeing the competition they had to meet, he thought the shareholders would consider the figures, when they were put before them, very satisfactory.

The resolution was then carried.

Nernst Electric Light, Ltd.

MR. BERNARD DRAKE presided at the fifth annual general meeting held at Westminster Palace Hotel, on Monday last. In moving the adoption of the report to September 30th, 1904, which appeared in last week's ELECTRICAL REVIEW, the CHAIRMAN said it was a source of satisfaction to the directors to be able to at last present a clean balance-sheet, and to propose to distribute a dividend. In accordance with the resolutions passed at the different meetings, the capital had been reduced from £320,000 to £90,000. This had involved a vast amount of work, and considerable anxiety, on both directors and staff. In connection with the reduction of capital, the assets of the company had to be re-valued, and they had adopted, as far as possible, the policy of writing down their tangible assets. The profit and loss account showed a profit of £4,840, as compared with a profit of £3,926 for the previous year, and a loss of £1,643 12s. 1d. two years ago. The profit on sales of lamps and British royalties showed an increase of £1,401 17s. 9d. over last year, which, in view of the disturbed state of some of the company's territories, such as China, Japan, and Asia generally, where trading operations had come practically to a standstill, must be deemed satisfactory. Further agencies had been established in the company's different territories, these now amounting to a total of 56. The item of £3,025 for administration expenses might appear to be high (it was £167 higher than last year). This was partly due to the fact that the company commenced advertising this year, and partly to the cost of a personal visit made to a number of the company's territories. An exceptional chance occurred of utilising the services of a member of a leading electrical firm who was visiting the East on other business, and the directors gladly availed themselves of this opportunity of obtaining independent reports as to the general working of their different agencies, and the direction in which progress might be anticipated in the future. Considerable benefit had been derived from this tour, the cost of which would have been prohibitive if undertaken exclusively for this company. It must also be remembered that although for the moment the lamps, or, at any rate, the vital portions of them, were being made for this company by the Allgemeine Gesellschaft, yet this company had to assemble the parts and also to examine, test when necessary, and pack the lamps over here before they were despatched to the company's territories, and this represented a good deal of technical and other work in the warehouse. Apart from this they must be prepared for eventualities, and must bear in mind that the present agreement with the Allgemeine was purposely made only for a limited period. Although they had every hope that the A.E.G. might be able to offer them such terms as would justify their making some fresh arrangements with them, the company would be unwise if they did not keep their technical branch sufficiently in touch with the different alterations to enable them to resume manufacture in their territories or elsewhere should this be found desirable. He was convinced that better results could be obtained by varying the proportions of the component parts of the lamp somewhat from the standard according to the technical data which they were able to ascertain concerning the variation of voltage which was likely to occur. Experiments had already been made in this direction from which he anticipated, after discussion with the Allgemeine,

some valuable results. The year's experience bore out the opinion he expressed at the last meeting, that although the lamp was most economical, it was of a delicate construction and required skilful handling, which was not always available. In spite of this, however, the number of lamps sold in the company's territories showed a steady increase, and in some of the districts, particularly where the voltage was regular, excellent results had been achieved. This was doubtless due to the fact that the lamp only consumed about half the current required by others for the same amount of light, and also to the superiority of the colour of the light produced. The question of the amount to be laid aside for depreciation of the value of patents had been the subject of considerable discussion, and, with the exception of one director, the board was of opinion that, considering the wholesale way in which the book value of the patents had been written down, the figure for this year (£1,250), at any rate, was all they needed to provide. In this connection they must bear in mind that as the patents run out, the goodwill of a business takes their place, and it was not at all unusual in commercial undertakings to find a company making as much or more money after the expiration of their patents, owing to the goodwill and connection which they had established. Further, in addition to the fundamental patents, they had other patents, taken out a later date covering the mechanical construction of the lamp in very much its present form, and they hoped that they might be able to further strengthen their position in this respect from time to time. The lamps as now made by the Allgemeine Gesellschaft contained many features covered by the patents taken out by himself and other members of the technical staff, which patents were given to this company without consideration and were most useful in making the present agreement with the Allgemeine Gesellschaft. Only recently they had made and shipped to the Allgemeine Gesellschaft a big consignment of lamp cases of this company's registered design for their own use, and these were also supplied by this company in considerable quantities in England. After referring to the directors' fees in regard to the future, on behalf of himself and colleagues, he might say at once that they placed themselves unreservedly in the hands of the shareholders, and he could not say more than that. In reference to Mr. Oppenheimer's (a director) circular and the directors' reply thereto, Mr. Oppenheimer had not to his recollection ever said a word about the directors' fees being in his opinion too high, nor had he to his knowledge made any suggestion that the general charges could be reduced.

Mr. J. G. DALZELL seconded the adoption of the report.

A lengthy discussion ensued. Mr. RUSHTON said that the directors ought to have added a clause to the articles when the capital was reduced, reducing the possible fees of the directors. Mr. HENLE said that the company was doing a commission business and nothing else, and suggested humbler offices and smaller staff, in order to enhance the small profits. Mr. ZUSMAN indulged in some reflections regarding certain members of the board, and asked Mr. Oppenheimer to withdraw his objection to Mr. Wallis Jones, against whom he had no grievance.

The CHAIRMAN, after further discussion, said that the board were ready to agree to £500 per annum, or any other figure, as the directors' fees for the current year.

A SHAREHOLDER suggested giving the directors an interest in the net profits.

Mr. KITCHIN asked whether the chairman could give an opinion as to the possibility of reducing the £3,000 odd for management and travelling expenses.

In reply to these and other questions, the CHAIRMAN said that the directors' fees could be altered from time to time at the meetings, and there was no necessity to alter the articles. Mr. H. Oppenheimer had asked what proportion of the profit was from royalties and what from the sale of lamps; the royalties amounted to about £2,000, and the profits from the sales to £6,000. It would be a mistake to retire into a back garret; the rent of the offices was only about £240 per annum, and considerable expense had been incurred in fitting them up with the needed appliances. They could not dispense with any of the staff. On the technical staff they only had one expensive man, who had been with him through all the manufacture, and with him was the only one who knew the manufacture of the lamp. In all the later lamps of the A.E.G. they had adopted a number of the improvements introduced by this company. No! they could not dispense with that technical knowledge. What they had every reason to hope for was that the percentage of general charges would go down.

Mr. H. OPPENHEIMER, who said that he held no brief either for Mr. Drake or for Mr. A. Oppenheimer, remarked that if they deducted the £2,000 for royalties they had an income of £6,600, of which £4,000 was absorbed in expenses. That was not a healthy state of affairs. There must be something wrong. It was high time that the company turned the corner, and brought its expenditure more into harmony with its earning power. They could not go on making expenditure without profits. Three-sevenths of the patent rights had lapsed, and when the patent rights had lapsed he would not give them 6d. for their goodwill.

Sir HENRY MANCE said that he had had Nernst lamps employed in his house from the beginning, and there had been a steady improvement. He hoped that the company would not dispense with the technical staff, on that ground alone.

The report was unanimously adopted.

A resolution that the directors' fees for the coming year be £500 per annum, was carried unanimously.

The re-election of Mr. R. J. Wallis Jones, M.I.E.E, to a seat on the board then came before the meeting.

Mr. A. M. OPPENHEIMER (a director) moved an amendment that Sir H. Seton-Karr be elected a director. This was seconded by Mr. RUSHTON, and led to a lengthy discussion, in the course of which Mr. KITCHIN asked what were Sir H. Seton-Karr's qualifications for becoming a director of this company—for putting his finger into this pie? They were, some of them, proposing to turn out an accomplished electrician who was well known in the City of London by reason of his work, and put in his place a member of Parliament who had so far as he knew no qualifications whatever for the management of an electrical company!

Mr. DRAKE (the chairman) intimated that he and his co-directors had resolved to resign their seats if Mr. Wallis-Jones was not re-elected.

Mr. A. M. OPPENHEIMER was asked to withdraw his objection to Mr. Wallis-Jones. He said that there had been differences between himself and the chairman. If they gave him their vote, he was prepared to give them a good solid board. Mr. Hirst appealed to Mr. Oppenheimer and Mr. Drake, now that they had had their differences and found out each other's strength, to see whether they could work together better.

After much more talking of a like character to the above, a shareholder moved the adjournment of the meeting for a month. This would give shareholders more time to send in their expression of view by proxies.

Mr. A. M. OPPENHEIMER protested against the adjournment, because it would injure the company's business.

A SHAREHOLDER retorted that it would also injure the company's business if Mr. Oppenheimer's resolution were adopted, and the technical element left the board.

The adjournment for a month was accordingly carried on a show of hands.

City and South London Railway Co.

THE directors' report for the half-year ending December 31st, 1904, to be submitted to the half-yearly meeting to be held at 71, Finsbury Pavement, E.C., on Tuesday, January 31st, shows that the receipts from all sources have amounted to £74,892, and the cost of working £35,369, leaving a profit of £39,523. Inclusive of the balance brought forward from June 30th last, the net revenue account shows an aggregate total of £40,225. After making provision for the debenture stock interest, and the transfer to the renewal fund of £1,500, a balance remains available for dividend of £27,445. The directors recommend that the full dividend of 5 per cent. per annum be paid on the preference stocks, 1891, 1896 and 1901, and that a dividend at the rate of 1¾ per cent. per annum be paid upon the consolidated ordinary stock for the half-year, leaving a balance of £1,450 to be carried forward to the next account. The following table shows the number of passengers, exclusive of season ticket holders, carried during the past six half-years, and the dividends paid in each half-year.

Half-year.	No. of passengers (exclusive of season ticket holders).	Receipts (including season tickets).	Dividend per cent. per annum on ordinary stock.
Ended June 30th, 1902	9,192,120	£76,843 12 3	3
,, December 31st, 1902 ..	9,877,199	82,131 7 1	3¼
,, June 30th, 1903.. ..	9,511,450	78,884 19 9	2¾
,, December 31st, 1903 ..	8,711,062	72,286 3 6	2
,, June 30th, 1904.. ..	9,226,987	76,887 14 1	2¼
,, December 31st, 1904 ..	8,401,846	70,705 10 11	1¾
Total since opening of line ..	134,709,114	£1,075,615 13 0	

There has been a decrease in the traffic as compared with the corresponding period last year, but this is attributable to the exceptionally fine and dry weather which prevailed during the greater part of the half-year, whereas the weather in the previous year was unusually wet. A slight diminution in the dividend is, unfortunately, the result. The arrangements with the various railway companies in respect to the Euston extension being now completed, a contract will be entered into for the construction of the extension. In providing the capital necessary for the work, it is found to be more economical to issue the stocks authorised at the last meeting as part of, and ranking with, the other stocks of the company and liable to dividend in the usual course, but arrangements are in progress by which the amount payable as dividend on these stocks will, it is anticipated, be met by receipts from other sources. The interchange traffic with the Great Northern and City Railway is increasing satisfactorily, and through bookings over this line with the suburban stations of the Great Northern Railway are now in operation. The decision of the House of Lords on the appeal of this company respecting the compensation paid in connection with St. Mary Woolnoth, has been given in favour of the church authorities. This is much to be regretted, as the directors had hoped to have recovered a considerable amount of the compensation paid.

Direct United States Cable Co.

MR. E. M. UNDERDOWN, K.C., presided at the half-yearly meeting held at Winchester House on Tuesday. He ran briefly over the figures mentioned in the report (printed in the ELECTRICAL REVIEW for January 20th) and said that there was a very marked improvement in the business during the last few months of the year. The reserve fund had been charged with the renewals which cost £8,477, and had been credited with the interest on investments £7,489. It had also been increased by the £10,000 placed to it for the half-year, and now stood at £472,964. The chairman then proceeded to give the main features of the pension fund which it was proposed to introduce. Such a scheme had been adopted by the Anglo Co. and by Government departments, and it was most important that they should be able to retain the services of their staff which was all of a very particular kind and valuable in itself. In order to do this they must cement the relations between themselves and

the staff. The old policy of endowment assurance would not be done away with but it would not be increased, and for the future the pension system would be substituted. Pensions would be payable at 60 years of age with a minimum period of 10 years' service; no pension to exceed two-thirds of the average salary for the last three years, or to exceed £500 a year, and no pension to be paid except out of the profits of the company. There are special provisions for employés obliged to leave before the age limit through ill-health or other cause. Dismissal for dishonesty or misconduct would involve forfeiture of any right to gratuity or pension. No contribution would be made by employés; the board would hold the fund and allow interest on it at 4 per cent. The fund would require an annuity of £2,500, but as they had already authorised expenditure of £1,000 under the endowment scheme, it would be necessary to increase that allowance by £1,500.

Sir J. PENDER seconded the adoption of the report, and it was carried unanimously.

Liverpool Overhead Railway Co.—The accounts for the past half-year show an available balance of £10,134 18s. 6d., and the directors have resolved to recommend payment of a dividend at the rate of 5 per cent. per annum on the preference shares, and 1½ per cent. per annum on the ordinary shares, against 1½ per cent. per annum on the ordinary shares for the corresponding period last year. Balance carried forward £3,743, against £4,132.

Anglo-American Telegraph Co. — After placing £10,000 to the credit of the renewal fund for the half-year, the directors will recommend at the meeting to be held on February 3rd the declaration of the following dividends for the year ending December 31st, 1904:—A balance dividend of 17s. 6d. per cent. upon the ordinary consolidated stock; a balance dividend of £1 15s. per cent. upon the preferred stock. There will be a balance of about £3,194 to be carried forward. The above dividends, together with those already paid, will amount to £2 15s. per cent. on the ordinary consolidated stock, and £5 10s. per cent. on the preferred stock for the year 1904.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—Commercial Cable Co.—Further issue of £29,000 sterling 500-year 4 per cent. debenture stock (redeemable). Edmundson's Electricity Corporation, Ltd.—Further issue of 10,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 70,001 to 80,000.

Cleveland and Durham County Electric Power Co.—An extraordinary general meeting of this company was held at Middlesbrough, when resolutions were passed creating the sum of £156,000 debenture stock, bearing interest at the rate of 5 per cent. per annum, to be issued when, and as soon as, the power to issue the same becomes exercisable. A further resolution was passed authorising the directors to dispose of the stock on terms likely to be most advantageous to the company.

Prospectus.—The *Havana Electricity Co., Ltd.*, was inviting until yesterday applications for an issue of £150,000 5 per cent. debentures of £100 each at 95. The company's works, it is stated, are now nearing completion, supply of current having commenced on January 1st. The works, plant, &c., to date have cost £180,000, of which £150,000 was provided by the issue in 1903 of share capital. The present issue will pay the remainder of the contractors' charges, and allow sufficient capital for house connections and working capital.

St. James's and Pall Mall Electric Light Co.—The directors recommend a dividend for the half-year ended December 31st of 7s. 6d., together with a bonus of 2s. per share, on the ordinary shares, making, with the interim dividend, a total distribution of 14½ per cent. for the year. This is at the same rate as for 1903.

Dublin and Lucan Electric Railway Co.—The directors propose the payment of 10 per cent. on the preference shares (reducing the arrears to three months), paying £200 off electrical equipment account, and carrying forward £275.

Metropolitan Electric Supply Co.—The company has inserted in its Various Powers Bill for next session provision for the reduction of capital from £1,000,000 to £750,000. The clause provides that at any time within 12 months after the passing of the Act it shall be lawful for the directors, pursuant to a special resolution of the company, to return and divide among the ordinary shareholders a further sum out of the purchase money for the Saint Marylebone undertaking of the company not exceeding £250,000. The reduction is to be effected by issuing three £5 ordinary shares to the holders of every two existing £10 ordinary shares, and by the issue of one £5 share and one-half of a £5 share to each holder of a single £10 ordinary share.—*Financial Times.*

Central London Railway Co.—The directors have declared dividends on the undivided ordinary and preferred stocks at the rate of 4 per cent. for the past half-year, and on the deferred stock 4 per cent. for the whole year. £30,000 is carried to reserve, and £22,000 forward. The dividends for 1903 were the same, but £10,000 was placed to reserve, and £36,000 carried forward.

Westminster Electric Supply Corporation.—The directors recommend a dividend at the rate of 15 per cent. per annum for the half-year ended December 31st, 1904, making, with the interim dividend, 14 per cent. for the year. The total for 1903 was 13½ per cent.

STOCKS AND SHARES.

Wednesday Evening.

THE rough shock given to the humanity of the world by the events of "Vladimir's Day," of course affected the Stock Exchange severely. While no panic broke out, there was a sharp fall in nearly all the markets. Amongst the few which escaped, were those for Japanese Government Loans and electrical issues. The latter are stoically steady, impervious to the nervousness that still continues to undercurrent the Stock Exchange generally, despite an all-round rally. A fall of 5s. in Great Northern Telegraph shares was the only movement directly traceable to the mad massacre of Sunday last, and this ¼ loss was regained to-day (Wednesday).

With the drop in Consols there naturally came a relapse in Home Rails, and although the Funds have experienced a certain recovery, the Railway stocks are slow to follow in the same path. Central London's have not changed, and City and South London keep at 46; the company's report affected the price in no way. Metropolitan Consolidated have receded to 97½, and Districts to 40⅜.

Traction descriptions have remained steady, and British Electric Preference are ¼ better at 11¼. The Second Debenture stock is offered at 97⅜, or at 98¼ for "free" stock. The latter means that the stock will be put into the buyer's name free of stamp and fee—in other words, that the company has probably not disposed of all the issue which was offered some time ago. Anglo-Argentine Tramway shares have paused at length in their upward career, and at 8 7/16 are ¼ lower, the Preference being a trifle down at 5⅝. Belgrano Ordinary fell away to 4⅛, but the "A" Preference at 6 and the "B" at 5½ are each ⅛ up. Argentine Railway stocks suffered badly from the slump that followed Sunday's news, but an improvement has since occurred. The Railway and the Traction markets are to some extent connected, and a shake-out in the first, or a boomlet such as lately happened, operates upon the other to a substantial degree. The London Tramway issues are fairly good. London Uniteds show no variation, but Metropolitan Electric 5 per cent. Preference hardened to 1, and North Metropolitan Tramways were sold at 4⅞ this week.

Dealings have commenced in City of Buenos Ayres Tramways 4 per cent. Debenture stock, and the price is quoted 98¼ to 99¼. It is thought probable that the stock will be issued about the end of the month, and transactions are being done for the "coming out" It is worth noticing that Anglo-Argentine 6 per cent. Debenture stands at 141½.

That Anglo-American Telegraphs should have descended with a run is not particularly surprising, in view of the dividend announcement. Readers here were fully prepared for Anglo "A" to go without interest for at least another twelvemonth, but the market appears to have thought otherwise. At all events, some bullish souls talked of ¼ per cent. being declared on the stock. Consequently the company's announcement of a dividend that made 5½ per cent. for the year on the Preferred stock, instead of the full 6 per cent., was regarded with something akin to dismay, and the Deferred has slumped 2½ to 10⅜. The people who wrote such glowing accounts of the stock to the newspapers just prior to the dividend declaration must feel that their optimism was a trifle premature. Anglo Ordinary fell 2 to 56, and the Preferred 1½ to 102. This last-named stock looks a fairly good lock-up of its kind, especially now that the directors of the company have shown no tendency to overstrain the balance-sheet by providing a shilling or two dividend for the Deferred.

Allusion has already been made to the slight fall in Great Northern Telegraphs, but the price is now 29½ again. A rise of ½ has occurred in Western Telegraph 4 per cent. Debenture stock. Callender's Preference are ⅛ higher at 5¼, and Henley's rose 5s. to 10⅜. Amazon Telegraphs have hardened to 1¼, showing a rise of a fraction.

National Telephone animation slackened off this week, but the Deferred at 109 shows a 2 point rise. This makes the Preferred and Deferred level as regards quotation. Chili Telephones are still in demand, and a further 2s. 6d. rise brings them to 6¼.

Electricity Supply shares are firm, awaiting the dividend announcements. The only weakness is provided by Metropolitan Ordinary, a fall of ¼ putting back the price to a level 18. City of Londons, however, are 10s. higher at 11⅜, Kensingtons ¼ better at 13, and Chelseas advanced a similar sum to 7 middle. The "City Lights" advance is giving rise to questions as to whether the City company and the Charing Cross are going to join interests in any way. St. James's shares are unaltered on the dividend, but on account of dividend talk, London Electric Ordinary added ¼ at 2⅛, and the South Metropolitan are 1/16 better at a shade below a sovereign. Of the lower-priced shares, Brush Ordinary lost ¼ at 12s. 6d., and the Preference at 1⅜ show 1/16 fall. Crompton Preference have risen 5s. to 2⅜. In narrow-market shares, such anxious times as these give rise to movements that are based more upon sentiment than logic, but the electric sections have withstood a trying ordeal with decided strength.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1902.	1903.	1904	Closing Quotations Jan. 18th.	Closing Quotations Jan. 25th.	Business done week ended Jan. 25th, 1905. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —102	99 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	¾— 1¼	1 — 1¼	1	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	60/6	61s.	2½%	57 — 59	55 — 57	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅓%	103 —104	101 — 103	104	101½
3,105,580	Do. do. do. Deferred	Stock	1/-	2s.	Nil	12¼— 13⅛	10⅜— 11	13	10
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	..	6 — 6¼ xd	6¼— 6⅜	..	..
18,338,300§	Commercial Cable	£100	8 %	..	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	95 — 97	95 — 97	96½	95
16,000	Cuba Telegraph	10	6½%	5 %	..	8⅜— 9⅛	8⅜— 9⅛	..	..
6,000	Do. 10 % Pref.	10	..	..	..	16⅞— 17½	16⅞— 17½	..	..
12,931	Direct Spanish Telegraph, Ord.	5	..	..	..	3⅜— 3⅝	3⅜— 3¾	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7⅞— 8⅛	7⅞— 8⅛	8⅜	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	100 — 102	100 —102	..	..
60,710‡	Direct United States Cable	20	3½%	3 %	..	10⅜— 10⅝	10⅜— 10⅝	10⅝	10⅛
78,500	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	..	..	..	99 —101	99 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	134 —137 xd	134 —137	136½	135
1,955,565	Do. 5½ % Pref. Stock	100	..	..	..	87 — 89 xd	87 — 89	88½	87½
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	105 —107	106½	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	13½— 14 xd	13½— 14	13⅝	13
250,000‡	Do. 4 % Deb. Stock	Stock	..	..	..	106 —108	106 —108	106⅝	106
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	101 —103	101 —103	..	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —102	100 —102	..	..
180,227	Globe Telegraph and Trust	10	£3 16 7*	5½%	..	10½— 10⅝	10½— 10⅝	10⅝	10⅝
180,042	Do. do. 6 % Pref.	10	..	..	..	14 — 14⅛	14 — 14⅛	14⅛	14⅛
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	..	29½— 29¾	29½— 29¾	..	..
50,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
17,000	Indo-European Telegraph	25	10%	10 %	..	45 — 47	45 — 47	..	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	3 %	3 %	..	⅞— 1	⅞— 1	..	..
1,955,338	National Telephone, Pref. Stock	100	6 %	6 %	..	108½—109½	108½—109½	109½	108½
1,966,667	Do. do. Def. Stock	100	4½%	5 %	..	106 —108	108 —110	110	108½
15,000	Do. do. 5 % Cum. 1st Pref.	10	6 %	6 %	..	13 — 15	13 — 15	14½	13½
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	..	12 — 13	12 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	..	5¼— 5½	5¼— 5½	5⅜	5⅛
000,000‡	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	..	96 — 98	96 — 98	97½	96⅝
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	..	101 —103	101 —103	102	101
1,000,000	Do. do. Prov. Certs., all paid	..	..	..	..	101 —103	101—103	..	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6½%	..	1 — 1⅛	1 — 1⅛	1⅛	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1⅛— 1¼	1⅛— 1¼	..	..
100,000‡	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	96 — 99	96 — 99	..	..
11,839	Reuter's	8	5 %	..	..	7 — 7½	7 — 7½	7½	..
8,808	Submarine Cables Trust	Cert.	..	..	..	120 —123	120 —123	..	..
58,000	United River Plate Telephone	5	7 %	..	..	6¼— 6⅜	6¼— 6⅜	6⅛	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	5 — 5⅛	5 — 5⅛	5⅛	..
179,947‡	Do. do. 5 % Debs.	Stock	..	..	..	104 —106	104 —106	..	..
15,609	West African Telegraph, Shares	10	2 %	4 %	..	7½— 7⅝	7½— 7⅝	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,009	2½	..	..	..	1/16— 1/16	1/16— 1/16	..	..
150,000‡	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brss. Sub. Tel.	100	..	..	..	98 —100	98 —100	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	13½— 14	13½— 14	13⅝	13½
75,000‡	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —103	101 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	100 —102	100½—102½	..	..
68,321	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
84,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	7⅜— 7⅝	7⅜— 7⅝	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	6½— 7½	6½— 7½	..	..
90,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	101 —103	101 —103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	7⅞— 8⅛	7⅞— 8⅛	..	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	9 — 9⅜	9 — 9⅜	..	..
800,000‡	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	96 — 100	96 — 100	..	..
100,000	British Electric Traction	10	8 %	..	..	9⅜— 10⅛	9⅜— 10⅛	9⅛	9⅛
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	11 — 11⅛	11⅛— 11⅜	11⅜	11⅛
600,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	118 —120	119 —121	119½	118½
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	95 — 97	97 — 99	98½	97½
100,000	British Insulated and Helsby Cables	5	10 %	8 %	..	5 — 5⅛	5 — 5⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104	101 —104	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	..	..	..	⅞— 1	⅞— 1	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	..	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	Nil	..	⅜— ½	½— ⅝	⅝	½
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	..	1⅛— 1⅜	1⅛— 1⅜	..	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	93 — 96	93 — 96	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	74 — 77	74 — 77	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	..	9½— 10	9½— 10	9⅝	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5⅛	5⅛— 5⅜	5⅜	5⅛
90,000‡	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —106	104 —106	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	..	91 — 93	91 — 93	92	91½
494,093	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	..	101 —103	101 —103	101½	..
494,993	Do. do. Def. do.	Stock	4 %	4 %	..	85 — 87	85 — 87	..	..
1,230,000	City and South London Railway	Stock	3½%	2½%	2½%	46½— 47½	46½— 47½	47	46⅝
85,000	Crompton & Co., Nos. 1 to 85,000	5	5 %	..	..	2 — 2¼	2 — 2¼	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	93 — 98	93 — 98	..	..
99,961	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,961	5	Nil	..	..	⅜— ⅞	⅜— ⅞	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	..	..	1 — 1¼	1 — 1¼	..	..
344,023‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	77½	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	79 — 84	..	..
112,100	lectric Construction 1 to 112,100	2	6 %	4 %	..	1¼— 1½	1¼— 1½	1½	..
81,390	Do. do. 7 % Cum. Pref., 1 to 81,390	2	..	..	..	2¼— 2⅜	2⅜— 2½	..	..
62,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 — 99 xd	97 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	..	..	9⅞— 10	9⅞— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	91 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	15 %	..	10½ — 10⅞	10⅜— 11	11	10½
200,000	Do. do. 4½ % Pref.	5	..	..	..	5⅜— 5⅝	5⅜— 5⅝	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	110 —112	110 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	..	..	15 — 16	15 — 16	15⅞	..
800,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	99 —102	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	..	..	3½— 3⅝	3⅝— 3¾	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10⅜	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	..	38 — 40	38 — 40	..	..
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101½—103½	101½—103½	..	..
540,000‡	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	..	90 — 92	90 — 92	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

(Bank rate of discount 3 per cent. (April 21st, 1904).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).— ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years			Closing Quotations Jan. 18th.	Closing Quotations Jan. 25th.	Business done week ended Jan. 25th, 1905	
		‡	1902.	1903.	1904.			Highest.	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£	8 %	10 %	..	10¾— 11	10¾— 11	..	..
20,000	Do. do. 7 % Cum. Pref. ..	£	..	..	..	10¼— 10⅝	10¼— 10⅝	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	105 —108	105 —108	..	..
50,000	Charing Cross and Strand Electricity Supply	£	10 %	8 %	..	8⅛— 8⅜	8⅛— 8⅜	8⅛	8⅛
70,000	Do. do. do. 4½% Cum. Pref. ..	£	..	..	..	5⅝— 5¾	5⅝— 5¾	5¾	5 15/16
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£	..	..	..	4½— 5	4½— 5	..	..
40,000	Do. do. 1903	£	..	..	..	4½— 5	4½— 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101 —103	101 —103	101¼	..
44,436	*Chelsea Electricity Supply, Ord.	£	4½%	5½%	..	6⅜— 6⅞	6⅜— 7⅛	7	6 15/16
150,000	Do. do. % Deb. Stock Red.	Stock	..	..	..	108 —110	108 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	£	5 %	5 %	..	11 — 11¼	11⅛— 12⅛	11⅞	11 7/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£	..	..	..	13¼— 14	13¼— 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	£	..	..	..	121 —125	121 —125	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid ..	100	..	..	..	101 —103	101 —103	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£	4 %	4 %	..	9 — 9¼	9 — 9¼	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60 ..	£	..	..	..	12 — 12½	12 — 12½	12 5/16	..
400,000‡	Do. do. 4½% Deb. Stock	£	..	..	..	107 —110	107 —110	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —103	101 —103	103	..
70,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	..	6¼— 6¼xd	6¼— 6⅜	6 5/16	..
70,000	Do. do. 6 % Cum. Pref.	£	..	..	..	6 — 6¼	6 — 6¼	6 1/16	..
300,000‡	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	106 —108 xd	106 —108	107	..
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	12%	..	12¾— 13	12⅞— 13⅛	13⅛	..
20,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —104	102 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	£	..	..	..	2⅛— 2⅜	2⅜— 2⅝	2 7/16	2⅜
49,840	Do. do. do. 6 % Pref.	£	..	..	..	5 1/16— 5⅛	5 1/16— 5⅛	5 1/16	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	96 — 98	96 — 98	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	£	7½%	8½%	..	18 — 18½	17⅞— 18⅛	18⅛	18
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅛	..
250,000‡	Do. do. 4½% 1st Mort. Deb. Stock	£	..	..	..	110 —115	110 —115	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 98	96 — 98	96	..
10,852	Notting Hill Electric Lighting	£	6 %	6 %	..	14⅜— 15	14⅜— 15⅛	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	102 —104	102 —104	103½	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14½%	14½%	14½%	13⅞— 14½	13⅞— 14½	14⅛	13⅞
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	£	..	..	..	8¾— 9	8¾— 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —100	98 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	2½%	4 %	..	2⅜— 3⅛	2⅜— 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	83 — 87	83 — 87	..	..
65,000	South London Electricity Supply, Ord.	£	12½%	8 %	..	4⅛— 4⅜	4⅛— 4⅜	..	..
100,000	South Metropolitan Electric Light and Power (Ord. ..	£	..	..	..	1/16— 1/8	1/16— 1/8	1/8	..
50,000	(*Late Blackheath and Greenwich* 7 % Pref. ..	£	..	..	..	1— 1 1/16	1— 1 1/16	..	..
100,000	*Dist. E.L.Co.*) 4½% 1st Deb. Stock	100	..	..	..	107 —110	107 —110	109	..
30,000	Urban Electric Supply, Ord.	£	..	..	..	5 — 5⅛	5 — 5⅛	5 3/32	..
30,000	Do. do. 5 % Cum. Pref.	£	..	..	..	5 1/16— 5 3/16	5 1/16— 5 3/16	5 3/16	5 1/32
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red ..	100	..	..	..	105 —107	105 —107	106¾	106¼
110,000	Westminster Electric Supply, Ord.	£	12 %	13½%	14%	13 — 13⅛	13 — 13⅛	13⅛	13 1/16
28,141	Do. do. 5 % Cum. Pref.	£	..	..	..	6⅛— 6⅜	6⅛— 6⅜	6⅜	6⅛

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, January 25th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	82/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 5	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£18	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£22	..
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	9d.	..
a ,, Caustic (75/80%)	per ton	£19	..
a Shellac	per cwt.	165/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£8	..
a ,, Bichromate, casks	per lb.	2½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
b Babbitt's metal ingots	per ton	£48 to £140	..
c Brass (rolled metal 9" to 12") basis	per lb.	7¼d.	..
c ,, Tube (brazed)	per lb.	9¼d.	..
c ,, ,, (solid drawn)	per lb.	8½d.	..
c ,, Wire, basis	per lb.	7¾d.	..
c Copper Tubes (brazed)	per lb.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	10½d.	..
c Copper Bars (best selected ..	per ton	£80	..

METALS, &c. (*continued*).		Latest Price.	Week's Dec. or Inc.
g Copper Sheet	per ton	£80	..
g ,, Rod	per ton	£60	..
e ,, (Electrolytic) Bars ..	per ton	£70 10	..
e ,, Sheets ..	per ton	£87	..
e ,, ,, Rod ..	per ton	£81	..
e ,, ,, H.C. Wire	per lb.	9¾d.	..
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
h German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	5/2 to 5/8	inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	48/-	1/3 dec.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£12 17 6 to £13	5/- dec.
g ,, ,, Sheet	per ton	£14 2 6	5/- dec.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 15	..
d Mica (in original cases) small ..	per lb.	6d. to 1/	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	..
p ,, rolled bars & rods	per lb.	1/0½ to 1/3	..
p ,, ,, strip & sheet	per lb.	1/2	..
o Platinum	per oz.	81/6	..
e Silicium Bronze Wire	per lb.	10d. to 11½d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£181 to £182	£1 dec.
n ,, Wire, Nos. 1 to 16	per lb.	1/7½	..
p White Anti-friction Metals—			
,, "White Ant" brand ..	per ton	£48 to £65	..
f Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	..
j ,, 8 ply 10 lbs. Russian ..	per lb.	4 13/16d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh's (Vieille Montagne bnd.)	per ton	£29 7 6	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Freder Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley an Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

Motor Tires.—The new Swinehart-Clincher "Colcave" type of tire, for which a life of 7,000 to 8 000 miles is guaranteed by the makers when running over ordinary roadways, is about to be placed on the English market by the Swinehart-Clincher Rubber Manufacturing Co., of America. It was recently exhibited in Paris by the Oldsmobile Co., fitted to cars. In order to secure resiliency the new tire is made "Concave," so as to be springy when running over rough roads, and has already been adopted on the new 1905 cars, by the Oldsmobile Co., of America, who, we are informed, have placed a large contract for use on their touring and parcel delivery vans now being exhibited at the New York Motor Show. We learn that Messrs. Shippey Bros. have been appointed sole importing agents, and that arrangements have been made with Messrs. Smith, Parfrey & Co., of the Pimlico Wheel Works, to build artillery wheels of any diameter and type of hub used by motor-car builders, and specimen wheels will be on view at Olympia fitted on several cars of English makers.

Belfast Tramway Engines.—Messrs. Combe Barbour are building three vertical triple high speed engines of the enclosed type for this tramway power station, for direct coupling to Westinghouse generators. Each engine will develop 1,550 B.H.P. at 180 r.p.m. Steam is admitted by piston valves to all the cylinders, and forced lubrication is fitted throughout. The engines will be built at the Combe Barbour works in Belfast.

THE TANTALUM LAMP OF MESSRS. SIEMENS & HALSKE.*

Part I., by Dr. W. v. BOLTON.

THE firm of Siemens & Halske has for many years been working at the problem of an economical incandescent lamp, and it arrived a long while ago at the fundamental principle that the visible part of the radiation of an incandescent body increases progressively with its temperature. This warrants the axiom that the most economical lamp will be that whose incandescent material will withstand the highest temperature.

Messrs. Siemens & Halske charged me several years ago with the task of discovering in their laboratory a material which should have a melting point considerably above the temperature at which incandescent lighting becomes highly economical, so that filaments made thereof would not melt nor disintegrate at that temperature.

There is a number of metals, the melting points of which are known to be considerably above 2,000° C., and the task resolved itself into finding one which, while fulfilling the above requirement, could be easily worked to form a filament, and would not be very rare or difficult to procure.

The melting point of vanadium obtained by electrolysis proved too low for the purpose in view. Niobium had a considerably higher melting point than vanadium, but not sufficiently high. Next tantalum was turned to. I reduced potassium tantalo-fluoride, and found that the finely-divided tantalum so produced became fairly coherent on rolling, so that by this treatment metallic strips could be made of it. On the other hand, it was tried to bring tantalum oxide into the shape of a filament by mixing it with paraffin, and to reduce it directly into the form of a metallic thread. In these experiments there was for the first time observed a minute globule of molten tantalum, and this globule was of sufficient toughness to permit hammering and drawing into wire. Following out this observation, tantalum powder was melted in a vacuum, and then it was found that the highly-heated metal parted with the gases it contained. In this manner I produced my first filaments of pure tantalum metal, which, however, were but small. When they had been used in lamps with promise of good results, an attempt was made to devise a definite process of purification. The potassium tantalo-fluoride was reduced to metallic powder; this powder contains a small proportion of oxide and of hydrogen which has been absorbed during the reduction. When the powder was melted in a vacuum the oxide and absorbed gas disappeared, and a reguline metal remained, and on carefully remelting this it became so pure that no appreciable impurities could be detected in it.

The chemical properties of this pure tantalum are very remarkable, and are of a kind to lead me to suppose that nobody before me has ever had metallic tantalum in his hands. When cold, the material resists chemical agents strongly; it is not attacked by boiling hydrochloric acid, aqua regia, nitric acid or sulphuric acid, and it is also indifferent to alkaline solutions; it is attacked solely by hydrofluoric acid. Heated in the air it assumes a yellow tint at about 400° C., like steel, and, also like steel, the tint changes to dark blue when the tantalum is exposed for some time to 500° C., or for a shorter time to 600° C. Thin wires of it burn, when ignited, with low intensity and without any noticeable flame. It greedily absorbs hydrogen as well as nitrogen, even at a low red heat, forming with them combinations of a metallic appearance, but rather brittle. It combines with carbon very easily, forming several carbides which, as far as they are at present known, are all of metallic appearance, but very hard and brittle. The product which Moissan has thought to be tantalum was clearly a carbide of this kind or an alloy of a carbide with pure tantalum, for Moissan himself states that his metal still contained ½ per cent. of carbon. Considering the high atomic weight of tantalum (183), it is obvious that a very small quantity of carbon suffices to carburise a relatively large quantity of tantalum. This view of the constitution of Moissan's product is confirmed by the properties he ascribes to the metal, namely, specific gravity 12·8, great hardness and brittleness; these are not properties of pure tantalum. When in the form of powder still containing, as previously stated, oxide and hydrogen, the specific gravity of my material is about 14; when purified by fusion and drawn into wire, it has a specific gravity of 16·8. It is somewhat darker than platinum, and has a hardness about equal to that of mild steel, but shows greater tensile strength than steel. It is malleable, although the effect of hammering is relatively small, so that the operation must be rather long and severe to extend the metal into a sheet. It can be rolled as well as drawn into very fine wire. Its tensile strength as a wire is remarkably high, and amounts to 95 kg. per square millimetre, while the corresponding figure for good steel is 70-80 kg., according to Kohlrausch.

The electrical resistance of the material at indoor temperature is 0·165 ohm for a length of 1 metre and a section of 1 sq. millimetre (specific conductivity as compared with mercury 6·06); the temperature coefficient is positive, and has a value of 0·30 between 0 and 100° C.; at the temperature assumed by the incandescent filament in the lamp at 1·5 watts per C.P., the resistance rises to 0·830 ohm for a length of 1 metre, and a section of 1 sq. millimetre. The coefficient of linear thermal expansion between 0° and 60° C. is 0·00000079, according to experiments made by the Imperial Normal-Aichungscommission. Fusion is preceded by a gradual softening which appears to extend over a range of temperature of several hundred degrees.

The specific heat is 0·0365, so that the atomic heat is 6·64, which is in accord with the law established by Dulong and Petit.

Part II., by Dr. O. FEUERLEIN.

As soon as Dr. Bolton's experiments showed that the originally brittle tantalum could be made ductile enough to draw into wire by the usual methods, and that this wire could be bent and coiled like a thin steel wire, it became possible to test it thoroughly as to its usefulness for incandescent lamps.

The first trials, with wires of about 0·3 mm. diameter, gave most promising results.

The first tantalum lamp that proved to a certain extent satisfactory, in that it admitted of an exact measurement of the electric and photometric conditions, and stood a burning test for some time, was completed just about two years ago, viz., on December 28th, 1902. This lamp had a bow-shaped filament made of the first wire drawn of tantalum. The diameter of the wire was 0·18 mm., its effective lighting length 54 mm., its electrical resistance when cold 0·29 ohm. This corresponds with a specific resistance (1 m. length, 1 sq. mm. section) of 0·331. The photometric measurements made at 2, 1½ and 1 watt per Hefner candle-power* showed pressures of 4·9, 4·95 and 5·9 volts, intensities of current of 5·0, 5·46 and 6·2 amperes, and illuminating values of 11, 18 and 37 Hefner candle-power respectively. On being burnt at 1 watt per candle-power, the lamp had a life of 20 hours, during which it strongly blackened.

In proportion as the chemical and mechanical process developed, and the material became purer, and the wires more uniform, the results obtained with the lamps also improved. The lamps lasted longer, and blackened less. At the same time, the specific resistance decreased until it dropped to the present figure of 0·165 for the pure metal. It is clear that the material used for the first lamps still contained a considerable quantity of impurities—probably niobium and carbides—which caused the strong dispersion and the nearly double specific resistance.

From the dimensions of the filament used in the first lamp, we could calculate that, with this rather impure material, we should require a filament about 520 mm. long and 0·06 mm. in diameter, for a lamp for 110 volts, 32 Hefner C.P. and 1·5 watts per C.P. These unusual figures increased when the specific resistance of the material had diminished to the present value of 0·165, at which for a 32 Hefner C.P. lamp a filament about 700 mm. in length × 0·055 mm. in diameter, and for a 25 Hefner C.P. lamp a filament of about 650 mm. × 0·05 mm. diameter was required.

In July, 1903, we possessed the first tantalum lamp with a filament of about 0·05 mm. diameter. It had a bow-shaped filament 54 mm. long, and its measurements were 9 volts, 0·58 ampere, and 3·5 Hefner C.P. at 1·5 watts per C.P. On the basis of these figures, a lamp having the same quality and diameter of wire, and at the same economy on a 110-volt circuit must have a filament 650 mm. long and would give 43 Hefner C.P. illuminating value.

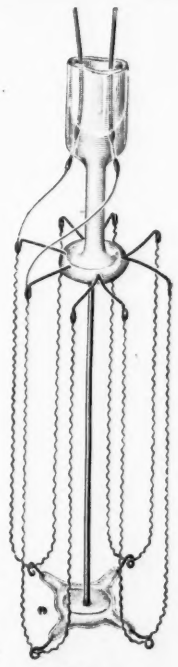


FIG. 1.

The experiments thus far had proved without doubt that the task of producing lamps for 110 volts and a maximum of 25—32 Hefner C.P. was not an easy one in several respects. We had to solve the problem of suitably and reliably fixing a filament rather more than 2 ft. long within a glass globe which should not exceed to any great extent the dimensions of the usual incandescent lamps.

* Abstract of paper read before the Elektrotechnische Verein at Berlin, by Dr. W. v. Bolton and Dr. O. Feuerlein, January 17th, 1905.

* One Hefner C.P. = 0·885 British C.P.—EDS. E.R.

Like all other metallic filaments which have hitherto been used for incandescent lamps, the tantalum wire presents the difficulty that it softens sensibly at the temperature corresponding with 1·5 watts per candle-power. To use loop-shaped or spiral filaments similar to the carbon filaments of the common incandescent lamps, was therefore out of the question. Nor did lamps made with bows of corrugated wire (fig. 1) or of plain or corrugated metal ribbon give satisfaction.

It soon became apparent that the one road to success lay in the direction of dividing the filament into a number of short straight lengths, supported at their ends in insulated holders. In this manner we succeeded at last, in September, 1903, in producing the first really serviceable lamps for about 110 volts.

This lamp is illustrated in fig. 2, and it will be seen that it contains two glass lenses cast on to a central wire holder; each lens carries laterally 12 arms having small hooks at their ends, and insulated from each other. Through these 24 hooks the thin tantalum

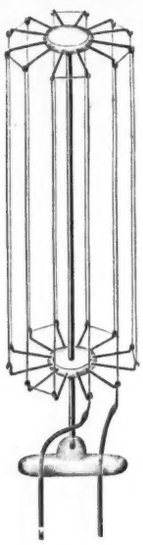


FIG. 2.

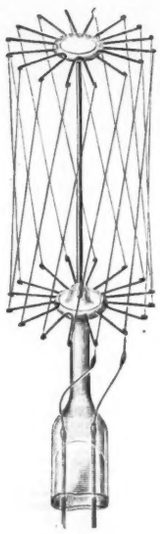


FIG. 3.

wire is drawn up and down between the two lenses. This is believed to the first metallic incandescent lamp for nearly 110 volts which, like the common carbon glow lamp, can burn in any position whatsoever. This lamp supplied about 30 Hefner C.P. on a 94-volt circuit at 1·5 watts per candle-power. It lasted for 260 hours, and lost during that time 9·5 per cent. of its illuminating value.

About the middle of October, 1903, we succeeded in making the first 200-volt tantalum lamp, which was of a design similar to the lamp just described.

In the course of further development, the form of the frame of wire filament for the 110-volt lamp went through different stages, the principle of sub-division being always followed. Among other constructions we tried some in which, instead of one long filament, a number of short pieces of wire were fixed on a supporting frame; those pieces, connected in series, made up the total length required. Fig. 3 represents a lamp thus constructed, the wire being joined obliquely in 16 straight pieces between two insulated supporting stars. Such lamps offer the advantage that short pieces of filament can be used in the manufacture. But they are only reliable if the wires used in the same lamp are absolutely uniform in diameter and quality. In the end we arrived at the shape represented in fig. 4, for 110 volts, 25 C.P., and 1·5 watts per Hefner C P.

In this form, differing from most of the previous constructions, the central support consists of a short glass rod carrying two lenses into which the arms, bent upward and downward in the shape of an umbrella, are cast. The upper star has 11, the lower 12 arms, each upper arm being in a vertical plane midway between the vertical planes in which two adjacent lower arms lie. Between these arms, which are bent into hooks at their ends, the entire length of the filament is drawn zigzag. Its extremities, held by two of the lower arms, are connected with the foot of the lamp by means of platinum strips.

The standard type for 110 volts, 25 Hefner C.P., and 1·5 watts per C P. has a filament 650 mm. long and 0·05 mm. in diameter. The weight of this filament is 0·022 grams, so that about 45,000 lamps contain together 1 kilogram of tantalum.

The shape of the glass globe is adapted to the frame described above. Care has been taken to make it of a size not exceeding the usual maximum dimensions of common incandescent lamps of the same candle-power (25 Hefner C P., 110 volts).

This shape offers a number of noticeable advantages. In the first instance it is very stable, and will stand severe shocks without damage to the lamp. A considerable number of such lamps were sent across the sea to test their resistance to the hardships of transport, and came back unhurt, although they had been packed just like common glow lamps, and no special care had been taken at any time in their handling. The lamp burns, of course, in any position, and can therefore be held in any kind of fitting. The light is white and agreeable; its effect is particularly steady if the lamps are provided with ground glass globes.

Numerous trials for lengthy periods of time, at rates varying within the range of 1 to 3 watts per C.P., have proved the vast superiority of the tantalum lamp over the carbon filament lamp under equal electric and photometric conditions. Expressing this fact in figures, we can state that the tantalum lamp consumes about 50 per cent. less current, at the same voltage, with the same intensity of light and the same useful life, than the carbon lamp does, or that it supplies about double the light of the carbon lamp with the same consumption of current; while at the same economy the life of the tantalum lamp is several times that of the carbon type. Moreover, at an initial load of 1·5 volts per Hefner C P., the tantalum lamp has an average life quite sufficient for all practical requirements, so that this rate of consumption has been standardised for the 110-volt lamp. Trials at a load of 1 watt per Hefner C P also proved that the lamps had periods of life of several hundred hours, but in that case the lamps were very sensitive to variations of pressure, and often showed an early decrease of illuminating value. The *useful* life of the tantalum lamp—*i e*, the life within which it loses 20 per cent. of its initial illuminating value—averages between 400 and 600 hours at 1·5 watts per Hefner C.P.; some specimens have proved to have a *useful* life of more than 1,200 hours. The *absolute* life amounts to an average of 800—1,000 hours under normal working conditions. Further, the tantalum lamp blackens but little, unless it has been strongly overheated during work in consequence of partial short-circuiting of the filament.

It is very interesting to observe the behaviour of the tantalum lamp during the whole course of its life. The first fact worthy of note is that, like some carbon lamps, the illuminating value increases at the beginning, generally after a few hours, by 15 to

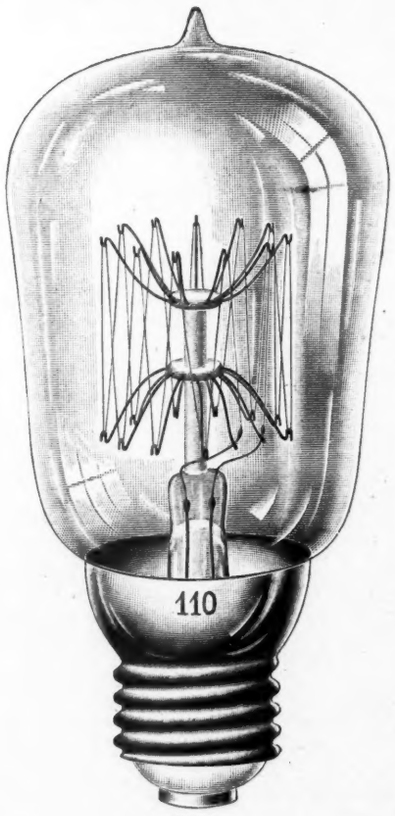


FIG. 4.

20 per cent. In the same way the consumption of current rises by about 3 to 6 per cent., while the consumption of power drops to 1·3 to 1·4 watts per C.P. After that, the illuminating value gradually decreases, while a corresponding increase of the consumption of power occurs.

The average behaviour of the 25-C.P. lamp at 110 volts, with reference to its various periods of life is shown in the following table:—

Life hours.	Intensity of light Hefner C.P.	Consumption in amperes.	Watts per Hefner C.P.
0	25—27	0·36—0·38	1·5—1·7
5	28—31	0·37—0 39	1·3—1 5
150	25—27	0·36—0·38	1·5—1·6
300	22—24	0 36—0·38	1·6—1·7
500	20—22	0·36—0 38	1·9—2·0
1,000	18—20	0·35—0·37	2·1—2·2

The initial increase of illuminating value, and of current consumed, is, doubtless, caused by a change in the structure of the tantalum wire, this change being accompanied by a reduction of resistance, and, consequently, of the phenomena resulting therefrom.

While the fresh filament has a perfectly smooth and cylindrical surface, the latter acquires a peculiarly glistening aspect as the filament grows old, so that a lamp that has served for some time can be readily distinguished from a new lamp. When looked at under the microscope, the filament that has burned for a length of time shows a clear tendency towards contraction and the formation of drops or beads.

Fig. 5 is an illustration of a piece of filament in its fresh state, and of the same piece after 1,000 hours of service, in both cases

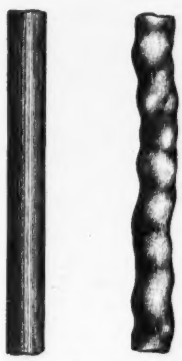


FIG. 5.

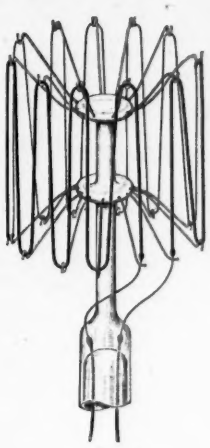


FIG. 6.

100 times the natural size. The gradual shortening of the filament can also be observed in the lamps themselves, and offers a further indication of the time of life of a lamp.

Fig. 6 represents the filament frame of a new lamp. It will be noticed that the tantalum wire is led up and down, and hangs loose on the supporting frame in easy wide arches without sharp bends. But after being used for some time the aspect of the lamp is quite different. As shown in fig. 7, the wire has contracted, the wide arches have disappeared, and sharp-pointed angles have taken their place.

Most peculiar is the behaviour of these lamps when the filament has burnt through. While with all other incandescent lamps the burning through of the filament is tantamount to the economical death of the lamp, it may happen with tantalum lamps that they burn through several times without being spent; on the contrary, each burning through is followed by an increase, often considerable, of the illuminating value. This peculiar result is due to the fact that in many cases a broken wire comes in contact with its neighbour, so that the circuit is again established. A part of the filament

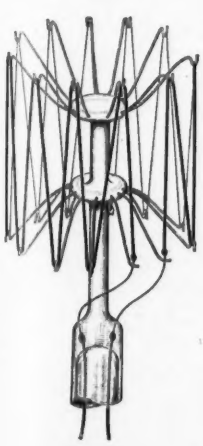


FIG. 7.

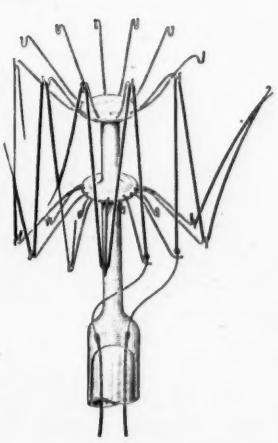


FIG. 8.

is thus cut out of the circuit, and the lamp consequently burns more intensely, and sometimes even too intensely, in which case, of course, only a short span of life is left to it. Yet we have had more than one lamp under observation, the filament of which broke for a first time after a short period of service and then broke repeatedly, but notwithstanding this the lamp lived more than 1,000 hours. We have often succeeded in rendering a lamp with a broken filament serviceable again by tapping it, to bring the broken piece into contact with its neighbour. Fig. 8 represents the frame of a lamp where the filament was burned through in three places and yet continued to do service. For the sake of clearness the back spans of the filament have been omitted in the drawing, while the front spans which were carrying the current, are drawn in specially heavy lines.

It must further be mentioned, that, after serving for some time, say, 200 to 300 hours, the tantalum filament loses a great deal of its mechanical strength; while tantalum wire, when new, has a greater tensile strength than steel, it becomes brittle and will break easily in the course of its life as a filament. It is, therefore, advisable, when lamps have served for some time, not to remove them from their old fittings and put them into new ones, as that might easily cause the filament to break. New lamps are not very sensitive to severe shocks, even while burning; but when this alteration in the filament has happened it is well to preserve them from shocks.

Of special interest to the incandescent lampmaker is the behaviour of the tantalum lamp under a heavy overload. As was to be expected, the trials made in this respect have also shown a great superiority of this lamp over the carbon lamp. It has been ascertained that tantalum lamps for 110 volts, 25 Hefner C.P. and 1·5 watts per C.P. only burn through at 260 to 300 volts, if the voltage is increased slowly and gradually, while with carbon lamps designed to work under the same conditions, nothing like that figure can be obtained. The superiority of the tantalum lamp over the carbon lamp with regard to less blackening of the glass globe can also be proved in a few hours by means of comparative burning tests at about 30 per cent. overload.

Another advantage of the tantalum lamp over the carbon lamp is that the resistance of tantalum, like that of all other metals, strongly increases with the rise of temperature, while carbon is known to diminish in resistance when it is hot.

In fig. 9 the variation of the resistance of tantalum and of carbon as a function of the lamp voltage is graphically represented, 100 being assumed as the value of pressure and resistance at the load

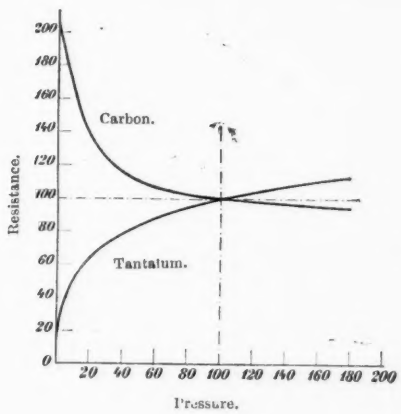


FIG. 9.

of 1·5 watts per Hefner C.P., so that for each per cent. of variation of the pressure, the respective percentage of variation of the resistance is shown.

It will be seen, in the first instance, that the resistance of tantalum increases to more than five times its original value during the transition of the material from the cold state to a load of 1·5 watts per Hefner C.P., while the resistance of carbon decreases with that change to about one-half of its initial value. It will further be noticed that, even at a higher load, the resistance of tantalum goes on rising, while the resistance of carbon keeps dropping. Therefore, the increase or decrease of voltage will cause the intensity of current, and with it the illuminating value, to rise or drop at a quicker rate in the carbon lamp than in the tantalum lamp, and consequently the latter is less sensitive to variations of voltage than the former.

Having thus related the whole history of the development of the tantalum lamp, and fully entered into a critical comparison between it and the carbon filament lamp, we need scarcely add that we do not intend, of course, to be satisfied with the results which we have obtained hitherto.

For the time being, however, and until a larger building has been erected for the production of tantalum, our firm has resolved to keep to the type for which there is an immediate practical demand; that is, the lamp for 100 to 120 volts, which gives 25 Hefner C.P. at 119 volts, or will have a higher or lower illuminating value if worked at correspondingly higher or lower voltages.

In conclusion, I would recapitulate the properties which we claim as peculiar characteristics of our invention, as follows:—

1. The tantalum lamp has a filament made of a metallic conductor, and burns at once on being connected, without any previous heating.

2. The light-giving wire is prepared by melting in a vacuum, and drawing; it is tough even in the cold state, and can therefore be coiled and spanned when cold.

3. A relatively great length of wire is placed in a simple manner within a bulb of usual dimensions.

4. Tantalum ore exists in sufficient quantities, and can be easily procured.

5. Similar principles of treatment can be applied to other metals of a very high melting point.

INSTITUTION OF ELECTRICAL ENGINEERS.

STREET LIGHTING BY ELECTRIC ARC LAMPS.

By H. B. MAXWELL, Burgh Electrical Engineer, Partick.

(*Abstract of Paper read at Glasgow, January 10th*, 1905.)

IF the requirements of effective street lighting are carefully studied, it will be found that what is wanted is, not an illuminant that most affects the eye, causing the pupil to contract so that other objects are indistinct, but one that illuminates the street and surroundings without this dazzling effect, and also one that has a maximum candle-power at an angle below the horizontal. For this reason arc lamps properly placed are infinitely superior to incandescent gas lamps, which, owing to the concentration and intensity of their light, the necessity for placing them comparatively low down, and owing to their maximum candle-power being at an angle above the horizontal, are one of the worst forms of lighting in this respect. It can undoubtedly be overcome to a large extent by placing the lamps much higher, but it is then necessary to increase the candle-power by grouping some three or four mantles together at a great increase in cost, in order to avoid the shadow cast by the pole in this form of lighting, and to provide sufficient candle-power to efficiently light the street at these heights.

An example of this form of lighting may be seen in Victoria Street, London, in the city of Westminster, and the reports of tests of the various forms of lighting in that city, carried out by Mr. Bradley, the city engineer, show that the average cost per candle-power per annum is the lowest in the case of arc lamps supplied by the Westminster Co., even at the high rate of £22 per lamp per annum.

In certain streets in Partick as many as six 3-ft. incandescent gas burners have been displaced by each 12½-ampere arc lamp, with the arc 25 ft. from the road level. With the gas lamps there was undoubtedly plenty of light, but objects on the road between lamps at a distance of 100 or 150 yards were indistinct, and in some cases quite invisible, whereas with the arc lamps similar objects were quite clear when 300 yards distant in straight streets. Surely this is the form of illuminant required for street lighting, for both police and traffic purposes.

The chief reason that arc lighting has not been more extensively used for street lighting is that station engineers do not charge low enough rates to make it commercially practicable, probably because they do not realise that street lighting has a load factor of over 42 per cent. Another reason is that, when a station engineer gets a street or two to light, his main object seems to be to cram as many lamps as possible into the space available, so as to increase the revenue, with no considerations of economy or of the most suitable positions of the lamps with a view to further extensions.

The first point to be considered is, whether open or enclosed arcs should be used. The open type is much superior for street lighting, as it is much cheaper to maintain, and the colour of the light is very much better. Only five enclosed lamps can be run in series on 480 volts, as against 10 open, if allowance is made for the resistance of cables, &c., and a 6-ampere enclosed lamp does not give as much light as a 10-ampere open. Enclosed lamps also do not run well in series.

A number of towns are now adopting smaller arc lamps for lighting their side streets, but the side streets require nearly as much light as the main streets in the majority of towns, and the decreased illumination can be sufficiently effected by keeping the lamps a little further apart. The advantages of having all lamps the same size are that all lamps are interchangeable, and only one stock of carbons and stores need be kept. The author is of opinion that the 10-ampere open type arc lamp, pendant from a swan neck or bracket, in all streets will be found most satisfactory.

Globes should be plain opalescent of such a density that the carbons are quite visible during the daytime. If the density is greater, too much light is cut off, and, if less, the light is not sufficiently diffused.

The height of a 10-ampere arc from the ground level should be 20 ft.; at this height the street is effectively lit, and the light is projected to considerable distances.

The distance apart is not of such importance as that lamps should invariably be placed at street corners so as to get the maximum efficiency from the lamps. In main streets, where there are tramways, the lamps may be placed from 60 to 80 yards apart to suit the corners; in less frequented streets this may be increased to 90 yards, and in side streets to 100 yards, or even more in special cases.

They should be placed on alternate sides of the road, except on curves, when they should be placed on the outside of the curve. A street lit with lamps staggered on alternate sides of the road is better lit than with centre poles, and with less obstruction to traffic. The use of tramway poles is not desirable, as the maintenance will be higher owing to vibration, and the higher ladders required, and failures will be more frequent.

There is no economy in using lowering gear, except perhaps in crowded cities, where it may be necessary to send a second man out with the ladder in order to prevent accidents. The capital cost of the lowering gears will be infinitely greater than the cost of ladders, and the maintenance of these gears must be exceedingly costly.

It is most necessary to control the street arc circuits direct from the station by separate feeders. By this means the whole is under the observation and control of the station staff, who can immediately tell from the feeder ammeters whether all the circuits are burning correctly. Also, if a section of distributor fails, it is of great benefit not to have the street lamps affected, and *vice versâ*. The arrangement with separate feeders obviates the necessity for men switching on and off at all hours of the night, which is an extremely wasteful and clumsy arrangement. The extra capital charges, &c., in the one case are very much the same as the extra cost of wages and current in the other. Time switches and remote control switches are unsatisfactory.

It is essential to have in the base of every pole an isolating switch and a substitutional resistance. An automatic cut-in must, of course, be provided, either in the lamp itself, or in the base of the pole. The author prefers the latter position, as the cut-in is then more accessible, and a third wire up the pole is unnecessary.

There are various methods of charging for street lighting; in some cases the lighting department borrows capital for the lamps, &c., and even maintains them, but for the purposes of this paper it is supposed that the electricity department borrows the necessary capital and maintains the lamps, the lighting department being charged on the estimated cost. All charges, both capital and revenue, should be kept entirely separate from the electricity account except the item for current only. The street lighting capital account should include all cables, roadwork, switchboards, &c.

The capital cost of installing 400 10-ampere arc lamps, with poles, resistances, cables, roadwork, switchgear, &c., will be about £24,000, so that the annual cost per annum, including all charges, will be—

	Total.	Per lamp.
7 per cent. interest, sinking fund and depreciation, on £24,000	£1,680 0 0	£4 4 0
Carbons—75,000 pairs at £4 10s. ...	337 5 0	0 16 10
Wages—Five trimmers, repair hand, and mate	455 0 0	1 2 9
Repairs, painting, &c.	100 0 0	0 5 0
672,000 units at 1d. per unit	2,800 0 0	7 0 0
	£5,372 5 0	£13 8 7
	say	13 10 0

The 7 per cent. allowed for interest, sinking fund, and depreciation will be found more than sufficient, as the greater part of the capital outlay is for mains, feeders, poles, roadwork, and labour, which depreciate very little. If the money is borrowed at 3¼ or 3½ per cent., the remaining 3¾ or 3½ per cent. for sinking fund and depreciation is sufficient to repay the loan in less than 20 years.

The figure given for carbons can easily be attained if short ends are saved and used in the spring and autumn. It is advisable to trim full during the four summer months, as then half the trimmers can be put on other work. The figure given in the estimate can only be attained by using the very best carbons.

The amount allowed for wages will be found sufficient in the majority of towns. Five trimmers have been allowed for, being 80 lamps per man; but in a number of towns, where the height of the lamps does not exceed 20 ft., each trimmer can attend to 100 lamps, making 50 per day in winter.

The question of current is the most important. The number of units allowed in the estimate is based on 3,500 lighting hours per year. The only items that should be included in the charge for current for street lighting are the works costs *exclusive* of wages (which should not be increased at all by the addition of a street lighting load) and interest, sinking fund, and depreciation on the capital cost for boiler, generator, and condenser plant. The cost of all cables, feeders, and switchboards has already been debited against the capital cost of the street lighting, so that £40 per KW. demanded, even after providing for a small amount of spare plant, will be more than sufficient to cover the increased cost of station plant due to the street lighting. Eight per cent. interest, &c., on this sum will be a charge of £3 4s. per KW. per annum, which, at 3,500 units per KW. per annum, works out at 0·22d. per unit. Any other items, such as insurance or office costs that may be increased by the addition of street lighting, will be amply provided for by 0·03d., so that a station can supply for street lighting at the following rate:—Works costs — wages + 0·25d.

If considered necessary a small addition to this price may be added for profit (every 0·1d. adding £280 to the revenue from 400 lamps), but, in the author's opinion, no such increase is necessary, as the decreased cost per unit of coal, stores, and repairs (especially the last item), owing to the much better load factor, will in itself cause a considerable profit. It must be remembered that the above method of making up the charge is based on the works costs previous to the adoption of an extensive street lighting scheme, and that the reduction in the works costs will not only affect the units for street lighting, but the whole supply from the station.

There are 54 stations in the *Electrical Times* records, in which the cost per unit for street lighting, if worked out on the basis given above, would be from 0·57d. to 1d. per unit, and which could therefore supply 400 10-ampere street lamps at prices ranging from £10 18s. to £13 10s. per lamp per annum (everything included), and yet the town with the lowest rate has no street lighting at all. In nearly all these 54 cases the charge actually made per unit is much in excess of this figure (in some cases being four times as great), and consequently only a small amount of street lighting can be obtained. Of those that also have a traction supply the charge for this is invariably much lower than that for street lighting, although the latter has a better load factor, requires no special plant, and, being a constant steady load, is not so severe on the plant. Moreover, in the price for traction supply is usually included capital and maintenance charges on feeders and switchboards.

Quite a number of the 54 towns are large cities, where arc lamps

can be employed to the best advantage, and where a powerful light is essential, and some of them have nothing but ordinary flat-flame gas burners which do nothing more than make the darkness visible.

From information received from about 50 towns, the average cost per lamp per annum of incandescent gas lamps, including gas, repairs and maintenance, wages, uniforms, &c., but providing nothing for capital charges or for buying new lamps out of revenue, is—

Single 3½ to 4-ft. burners	...	...	£2 10 0
Two " "	...	...	4 10 0
Three " "	...	...	6 15 0

The candle-power of these on the street after 50 hours' use will respectively be 40, 70 and 100 C.P.

There is not the slightest doubt that a very large number of towns can light their streets with arc lamps as cheaply as with incandescent gas, and with a large increase in light, provided the arc lamps are judiciously placed and the whole scheme has been carefully designed.

Again referring to Mr. Bradley's report, the average candle-power of a 10-ampere arc lamp with opalescent globe is ,637, which, at £13 10s. per lamp per annum, works out at 5d. per C.P. per annum, a figure which could not be equalled by any other form of lighting, the average obtained from ordinary incandescent gas lighting being 1s. even when taking the nominal candle-power of the mantle.

To emphasise the importance of electric street lighting, it may be stated that, even in a comparatively small town like Partick, the revenue from current alone from the 300 street lamps amounts to nearly £3,000 per annum, and in carrying out the scheme some £18,000 has been spent with manufacturers in this country.

ARMATURE REACTION IN ALTERNATORS.

A PAPER was read on this subject at Glasgow on December 13th by Messrs. J. B. Henderson, D.Sc., and J. S. Nicholson, B.Sc., dealing with the results of an investigation which they had carried out in the James Watt Laboratories of the University of Glasgow. The authors first discuss the theoretical aspect of the question, analysing the magnetomotive force due to the armature current with regard to the distribution of the armature winding over the core, and calculating the resultant effect of the three phases of a 30-KW. three-phase alternator. The reaction is split up into demagnetising and cross-magnetising components, and a method of graphically pre-determining the load curve for any output is developed.

To put their theory to the proof, the authors carried out an elaborate series of tests upon the generator at various power factors and loads. Every precaution was taken to secure accuracy, and the numerous curves given in the paper, representing the results of the experiments, show a remarkably close correspondence between the calculated values and the actual observations, the deviations being negligible from the standpoint of the designer.

ON BATTERIES WITH REVERSIBLE BOOSTERS.

By C. TURNBULL.

(Abstract of Paper read at Newcastle, December 12th, 1904.)

SOME time ago I found it necessary to go into the question of having a battery and automatic reversible booster for use on the traction load at Tynemouth. The result of the investigation was the birth of the Lancashire automatic reversible booster, which was brought out under the patents of Mr. McLeod and myself, by the Lancashire Dynamo and Motor Co., of Manchester. In putting the machine into various stations a number of points have come up in connection with the batteries, which may be of use to such engineers as are putting down batteries for use under similar conditions.

It has now come to be recognised that the best way to deal with a very fluctuating traction load is to put in a battery and reversible booster. The idea has gained currency that a booster should be designed to keep the load on the generator always at a steady value.

In some cases where the output is fairly regular from day to day, and where the maximum demand keeps within limits, this solution of the problem is quite good, and a very efficient and good working plant is obtained. In many cases, however, this solution is of no use at all. The output varies from day to day. Likewise a large part of the day is slack, with a heavy output during certain hours only. If in addition to this we have heavy and irregular peaks at all times, we must solve the problem in quite a different manner. Constant load on the generators can only be got in cases where the load is similar every day, and keeps on fairly regularly throughout the day, and where the size of the generator can be fixed so as to put out the proper amount of current every day at about full load. Of course, in many cases, a good deal can be done by varying the number of hours that the generator is run, so as to provide just the number of units required to meet the load and to keep the battery properly charged.

The booster should have very flexible properties. It should, indeed, fulfil the following requirements:—

1. When required, it should work so as to keep the load on the generator approximately steady. This will be needed when the demand for current is approximately equal to the output of the generator.

2. It should be possible to vary the apportionment of the load between the battery and generator.

3. On a slack day with occasional peaks, the battery and booster combination should be arranged to respond to the peaks only, and otherwise do practically nothing, so as not to overcharge the battery.

4. For periods of very light load, the booster and battery should be arranged to go on to the bus-bars without any generator. In this case the booster should be arranged to compound up to counteract the drop of volts in the battery.

A booster worked by the feeder currents only will not fulfil these requirements, as such a combination will tend to take the load off the generator when the battery is fully charged, while it will be sluggish and unresponsive when the battery is down at all in volts.

Given a booster with the above properties, it is not difficult to arrive at the size of the cells. Thus with an output of 3,000 units per day of 16 hours, we can do it with a generator which will give 200 KW. as ordinary full load, with, say, a 25 per cent. overload capacity to meet excessive and occasional rushes. We must then put in a battery which will be large enough to meet the maximum load of the station when running in combination with the generator.

The actual work done by the cells when working with a reversible booster is very little. We therefore want a cell which will do with very heavy discharges and charges, but that does not necessarily have a large long-hour capacity. Durability is more important than efficiency. I have been informed that a cell to meet those requirements can be made and maintained at about half the ordinary price, if it be asked for.

The possible variation of cell voltage is from 1·8 to 2·7 volts per cell, the last figure being obtained with the fortnightly overcharge which makers recommend to be given to the cells. In ordinary working the variation is from 1·9 to 2·5 volts. 250 cells is a suitable number where the bus-bar pressure is between 500 and 550 volts.

It is necessary in working to ensure that the battery has just the right proportion of current put into it.

The advice is sometimes given that the booster should be worked so that the battery is charged every night at shutting-down time. This is impracticable without an undue amount of attention. The most practicable way that I have found is as follows: During the morning, when the generator is started up, there is usually a slack time, so that it can be arranged that the battery is mainly charging. The battery attendant should now go round and see that every cell gases up at the same time, and top up any cells with water, if necessary. When the cells are full up, the attendant should inform the engine room staff, so that the booster can be so regulated, that the battery can be discharged for a time rather than charged. When a little current has been run off, the adjustment can be made so that charge and discharge are about equal or as needed. This method of working the battery needs a minimum of attention, and will be found very satisfactory in practice. Once a fortnight an extra charge can be put in, which will bring the voltage up to 2·6 or 2·7 per cell. The volts of each cell can then be taken on the top of the charge. The gravities of the cells can also be taken at the same time.

It is possible to reduce the amount of the maintenance payment by stipulating for the battery to be kept up to, say, 90 per cent. of its original capacity instead of to the full capacity, and this is usually quite enough for reversible booster work. The maintenance agreement should be settled as to terms before the order for the cells is definitely placed, and the user of the cells should stipulate for six months' use of the cells before deciding whether to enter into the maintenance scheme or not.

Too much light in a battery room is bad, as it renders cell inspection difficult. The room should be rather dark, with good artificial lighting. The ventilation should be good.

The grating for the battery room floor can be made of rough wood dipped into melted pitch. This makes quite a cheap and satisfactory arrangement.

The motor breaker should be arranged to shut off the battery current, if it comes out, so that the booster may not race owing to the battery current running through it. On the other hand, it is desirable to have the breakers arranged so that the blowing of the battery breaker does not stop the motor.

Watt-hour-meters may be used with the shunts taken off the bus-bars, so that they virtually become ampere-hour meters. It is not essential that the integrating meters should be absolutely correct, but it is essential that they should agree with each other, or that their differences should be known.

Several shunts in series—one for the ammeter, one for the recorder, and one for the integrators—should be avoided. One shunt should do for the lot.

In some stations I think it would be a good thing to couple the booster to the main generator shaft, so as to save motor losses, and to run traction and lighting dynamos in tandem on the same engine. Where a reversible booster was in use, the load on the traction generator would be steady enough to prevent flickering on the lighting boards due to variations in the engine speed. The lighting dynamo could have the mid-wire connection through choking coils, which would obviate the running of a balancer in the daytime. Given, say, some 200 KW. on the traction and, say, 100 KW. on the lighting all day long, then the combination would provide quite a good load for a 400-KW. or 500-KW. engine. If the condensing plant were run direct off the engine, shafting by chain or other gearing, we would have a very economical omnibus plant for many stations. The amount of current that runs to waste nowadays in running balancers and motors for various purposes is so enormous that it is worth while to do something to save it.

REVIEWS.

The Testing of Continuous Current Machines. By CHARLES KINZBRUNNER. London: Harper Bros. 1904. Price 6s. net.

In this excellent book of about 300 pages, the author deals comprehensively with the subject of direct current machine tests. He has assumed an elementary knowledge of electrical theory only, and in the development of his subject has taken considerable pains to explain all points which might present difficulties to students who are not accustomed to apply practically the knowledge of electrical phenomena which they have obtained from lectures and text-books. Mr. Kinzbrunner, who has had experience in organising a very complete set of laboratory experiments at the Manchester School of Technology, leaves very little to be desired in the general arrangement of the book and method of treating his subject. Each test is fully explained and a diagram of connections given, together with a list of instruments and apparatus necessary for each experiment, this being followed by an actual example of the test in question with tabulated results, curves, and further explanations.

The first five chapters of the book contain descriptions and illustrations of instruments and test room apparatus of all kinds, as well as some general hints on the testing of machines. In Chapter III. there are some useful remarks on the measurement of temperatures, the method of external measurement by thermometers placed against the windings being rightly deprecated as being a very poor guide to the actual temperature of the coils. The method of temperature measurement by means of thermo-junctions is also mentioned, but it is surprising to see bismuth recommended as one of the metals for the couple when other substances, much more easily obtained and worked, give equally good results. Heirlooms like these seem to get handed down from one text-book to another, and become more and more sacred at each repetition. On page 17, for instance, the "temperature coefficient" of platinum is given as 0·243. Perhaps some impure sample 10 years ago was found to have this value, but modern platinum has a coefficient of 0·389 per cent. per degree, causing something like a 40 per cent. error, if the value given in the book be taken for use with the platinum thermometer measurements suggested on page 51. In this connection (see page 17) it might be pointed out that the temperature coefficient is not the percentage, but the actual, variation in the resistance of a material per 1°C.

Chapters VI. and VII. contain a very exhaustive set of tests on a number of 1 to 4-KW. machines illustrative of the effect of variations of load, excitation, speed, &c.; and Chapters IX. and X. deal with efficiency and the separation of losses. Hysteresis and eddy current losses are separated to a considerable degree of accuracy, on the assumption that the former varies directly as the speed and the latter as the square of the speed, which, of course, assumes a fact which is not yet fully established.

There seems to be some confusion at the top of page 256, where the positions of points on the curve do not tally with figures given for their co-ordinates.

The last chapter, on practical testing, will be found most useful to all who have to test or superintend measurements on direct current machinery. Extracts are given from the report of the Committee of Standardisation of the American Institute of Electrical Engineers, bearing on the subject of the book, and the notes on commercial testing of machines and convenient forms of test books for workshop use, form a valuable practical addition to this excellent volume. We confidently recommend this book to all who have to do with electrical machinery, and who desire to have an intelligent grasp of the principles underlying the apparatus under their charge. C. C. P.

L'Ozone et ses Applications Industrielles. By H. DE LA COUX, Ingénieur Chemiste. Paris: Vve. C. H. Dunod. 1904. Price 15 fr.

This new French work upon ozone and its industrial applications demands attention—if only by reason of its size and pounds avoirdupois—but it is certainly no light task to review adequately a volume of 557 pages, containing 159 figures, within the limits allotted to notices of technical works in this journal.

The book is divided into four sections, the various chapters of which are arranged in the logical sequence which distinguishes most French books of a scientific character.

Section I. contains five chapters discussing the chemical, physical and physiological properties and characteristics of ozone. It is not generally known that ozone can be obtained in the liquid form, and the author gives some interesting data relating to the experimental investigations made by various scientists upon the liquefaction of ozone by compression and cooling, and upon the boiling point of the liquid product. This is given as — 119° C., and a new method of producing ozone from liquid air has recently been based upon the stability which characterises liquid ozone, as compared with that of the gaseous product. The author has not, however, so far as we can discover, made any reference here to the new method, which may become of considerable importance.

Section II. deals with the production of ozone, and is divided into four chapters, with numerous sub-divisions. The various methods of producing ozone, namely, the thermal, the chemical, the electro-chemical and the electrostatic discharge methods, are described and illustrated; and these four chapters will prove the most valuable part of the book. The sub-section of Chapter IV., describing ozonisers intended for industrial use, occupies 60 pages, and in this all the well-known types of ozoniser are adequately discussed. Some of the illustrations in this chapter are new, but many of them have done duty before in the ELECTRICAL REVIEW, as illustrations to the numerous articles on ozone which we have from time to time published.

In Section III. the industrial applications of ozone, depending upon its chemical and sterilising activities, are dealt with, no fewer than 22 chapters being included in this portion of the work, each dealing with some particular application or industry. A great mass of valuable information, relating to the practical applications of ozone in the arts and industries, is contained in this section of the book, which covers over 270 pages.

It may be stated here, however, that ozone has not yet been made both a practical and an economic success in the 22 different applications described by M. de la Coux in this section of his treatise, and in many cases the records are merely of experimental character and value, as the attempts ended in failure. For those interested in the industrial applications of ozone, these chapters are none the less worthy of the closest study, for from a scientific point of view a careful record of experimental failures is of more value than similar records of successful trials and processes. It was a wise Greek who first stated that we learn less from our successes than from our failures in life, and the attempts to apply ozone in the arts and industries are full of illustrations of the truth of this aphorism.

Section IV. of M. la Coux's book deals with the detection and determination of ozone, and is divided into three chapters. In these both the qualitative and quantitative methods of examining gaseous mixtures for ozone are described, and numerous illustrations are given of the apparatus employed.

The above sketch of the plan and contents of the book shows it to be one of the most valuable and comprehensive yet published, and it will doubtless take rank for some time as the standard work on the production and applications of ozone.

The only words of criticism we have to offer are, that M. de la Coux should give references to all the original literature of the subject in the next edition of his monumental work, that more information should be included with regard to English experimental work on ozone (as, for instance, on the trials at Lea Bridge, for water sterilising purposes), to the volumetric method of determining ozone in gaseous mixtures, and that both a name and a subject index should be added to the volume.

A scientific book in these days loses half its value as a reference work if no details of the original literature are given, and if the absence of a copious index leaves readers

hopelessly stranded in their attempt to find quickly what they are in search of. In both of these respects, the book before us is imperfectly fitted to become a standard reference volume.

In any future edition or translation, it would be well therefore to adopt these suggestions, and we would also point out that on pp. 248 and 264, chemical equations are given which are lacking in accuracy, and require revision.

The book is well printed and illustrated, the type being large and the illustrations clear and distinct, and in spite of the defects named above, it forms a very valuable addition to the literature of the subject.

Electricity in the Service of Man. By R. MULLINEUX WALMSLEY, D.Sc. London: Cassell & Co. 1904.

The present edition of this well-known work, a first issue of which appeared in 1888, has been completely revised and re-modelled, forming a radical departure from its predecessors.

In order to bring it into line with modern views and practice, the author has sub-divided it into two main sections, of which the first deals with the elementary principles of electrical science, and traces its historical evolution, whereas the second contains the technology of the subject, giving an account of the methods, machines and apparatus employed in the various branches of electrical engineering. The author is to be congratulated on the general excellence of his work, which enables the student to obtain a sound elementary grasp of first principles and their general applications.

The historical notes are exceedingly interesting and instructive, and their compilation must have entailed a heavy amount of work.

In addition to an introduction on early history, Part I. contains 18 chapters, in the first seven of which are concisely set forth the principles of magnetism and electrostatics, the electric current, Ohm's law, and the chemical, thermal and magnetic effects of the current. Electro-magnets, the telegraph, magneto-electric induction, the telephone, the continuous current dynamo, alternating current generators and electric motors are very carefully explained, and their development sketched in separate chapters. The ordinary measurements in continuous and alternating current circuits are also very simply and lucidly expounded; and, further, there are chapters on the electric transmission of power and the electric discharge.

The figures and diagrams illustrating both magnetic and electrostatic fields of force under different conditions appear to us especially good, and Faraday's classic ice-pail experiment is rendered easily intelligible by their aid. We may especially commend the author's use of heavy type, notably in the chapters on measurements, to bring into prominence definitions and fundamental laws, following the practice of several text-books, by means of which these ideas are more readily fixed in the memory of the reader.

In Part II, on the technology of electricity, the author in his introductory remarks explains his reason for arranging this section in two sub-divisions. In the first division he proposes to deal with the generation, transmission and utilisation of electrical power, and to devote the second to the practical applications of small electric currents.

In the present volume only a portion of division I. is included, as it was impossible to present the whole subject and give the history and principles in one book, without unduly increasing its size. The author intends incorporating the omitted sections in a future supplementary volume, to which we shall look forward with pleasure.

The second part of the book comprises seven chapters, six of which treat almost exclusively of dynamos and motors for continuous and alternating currents, methods of testing, running dynamos in series and in parallel, and the parallel working of alternators. This very important subject is exhaustively and clearly placed before the reader.

The final chapter is on electrical measurements, and concludes with descriptions of some well-known continuous and alternating current supply meters, and power factor indicators.

In connection with the Aron watt-hour meter, we notice a slight error in the explanation given of this meter's freedom from disturbance by stray fields.

The author states that external stray fields do not affect the meter, because the pendulum bobs are similar and carry oppositely directed currents, making an astatic combination.

The correct explanation is as follows:—The pressure coils on the pendulum bobs are similarly wound, *but are each traversed by the shunt current in the same direction*, so that each presents the same polarity to the series coil above which it swings. *The series coils are oppositely wound*, and the main current flows in one in a clockwise, and in the other in a counter-clockwise direction. The result is, of course, that one pendulum is retarded and the other accelerated. If the meter be subjected to an external stray magnetic field, the pendulum bobs will both be influenced in exactly the same way, *i.e.*, each will be either accelerated or retarded. This will not, however, in any way affect the meter readings, as they depend *solely on the difference in the rates of the two pendulums* and not on the actual speed of either.

The whole book is very well illustrated, and contains excellent diagrams and prints of modern representative dynamos, &c. A very full index is also added.

ABSOLUTE SMOKE ABOLITION.

ON Wednesday last week we had the opportunity of inspecting a Cornish boiler fitted up with a smoke-preventing device at 26, Page Street, S.W.

When we discovered that the inventor of the apparatus was Mr. Greaves, the inventor of Premier tubes, we were somewhat surprised, for this new apparatus is just the opposite of his old invention in the principles on which it is based.

Amongst the printed matter handed round we found four essentials of perfect combustion which strongly savoured of a paraphrase from a recent book on "Smoke Prevention and Fuel Economy," and Mr. Greaves delivered to an audience of pressmen and engineers an address on the subject of combustion which was really sound. Even the convert at the eleventh hour should be welcome to the fold, and we hope Mr. Greaves will now for ever turn his back on all manner of water-filled tubes in a furnace or combustion chamber. Surely he has already done so, for he lays it down as an essential of perfect combustion that there shall be room for the combustion of the fuel gases and mixed air, and so he appears to us to put cross tubes out of court when smokelessness is to be assured. In his new invention he makes blocks of fire-brick about 9 in. thick, with a central hole of about 3 in., and builds these into the flue tube of the boiler beyond the bridge with about a 2 in. vertical space between each block and its neighbour. Thus all the gases pass through these holes and narrow slots in heavy lumps of firebrick, which become highly heated between stokings, and supply the additional heat and mixing that serve to overcome the critical point in combustion and enable bituminous fuel to be burned smokelessly. It was burned smokelessly last week, with a thick fire and air admission at the door. The draught was fairly good, and none of the coal was above ⅝ in. to ½ in., being apparently Yorkshire fine slack. Indeed, we should call it a good class smithy coal, moderately smoky and not dusty. We cannot say that under the circumstances smoke might not have been prevented without the apparatus, but we do think it would have been doubtful, or at the best, more difficult to do so.

The trouble with firebrick linings always has been that they soften, melt and generally fail to stand the heat. The blocks employed in this apparatus are claimed to be peculiarly refractory, and to be made five-sixths of ganister. They appeared to be good, but absolutely nothing can be said as to their endurance from a brief inspection. They are simply built up in the flue, and do not require any alteration of a boiler or any cutting or drilling, and they can be put in in a few minutes under favourable conditions. They are certainly an embodiment of a sound principle, and if their durability can be proved, they should find a considerable field, for, as we have often said, the internally fired boiler is one that is always near the critical line of smoke or non-smoke conditions, and very little serves to produce one condition or the other.

The division into fine streams of a mixture of air and gas that is not ordinarily combustible is powerful in effecting combustion, and possibly it is this effect which partially explains the action of the present apparatus.

We should have liked to remove the blocks altogether, so as to ascertain the difference without them. With them, smoke was certainly prevented *under the conditions named*

We were told by the chairman of the syndicate that this was not a company promotion matter, but was to be worked as a genuine business.

"The apparatus has been tested by Messrs. Burstall & Monkhouse. We cannot say much for the report, especially since they base the good results with the apparatus upon a boiler efficiency of only 59 9 per cent. without the apparatus Nor do we like the statement of evaporation per pound of carbon value of the coal. What does this mean? What is the carbon value of a bituminous coal? Why is the hydrogen omitted? Is this a proper way to state the results of a test with bituminous coal?

We are by no means strong advocates of huge economies to be got by smoke prevention. The boiler surfaces will be kept more efficient, but economy is apt to be sacrificed where smokelessness is secured by means of excess of air. Economy may be secured to a small extent by careful air regulation.

The report does not give the figures of the CO_2 determination stated to have been made. While much inclined to a favourable view of this latest method of arranging blocks in the flue, we should like to see a test with and without the blocks, with ordinary bituminous fuel selected by ourselves. The apparatus does merit attention, and as it can be easily applied, will not harm the boiler, and will cost nothing, if it does not succeed, steam users troubled with smoke may well try how the blocks will serve in their own case, no other conditions being altered.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

380. "An improved insulated roller contact block for electrical traction." W. AINSLEY. January 9th.

392. "Improvements in controlling the luminosity of electric lamps and their consumption of electric current." F. A. HUNTER. January 9th.

400. "Improvements in means or apparatus for controlling electric and other circuits." G. HARRISON. (The Albert and J. M. Anderson Manufacturing Co.) January 9th. (Complete.)

401. "Improvements in under-running current collectors for electric railways." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) January 9th.

402. "Improvements in thermal electric cut-outs." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co, United States.) January 9th.

403. "Improvements in and relating to electric heaters." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) January 9th.

404. "Improvements in electric switches." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) January 9th.

405. "Improvements in electric resistances." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) January 9th.

410. "An improved electrical hydro-pneumatic governor for marine engines." R. J. W. GRASSET. January 9th. (Complete.)

416. "Improvements in or relating to electric insulators." H. J. TRAUTMANN and J. L. COPPING. January 9th.

417. "Improvements in or relating to electric switches." H. J. TRAUTMANN and J. L. COPPING. January 9th.

421. "Improvements in or relating to single lines of railway on the electric staff or other electric systems." C. M. JACOBS. January 9th.

432. "Improvements in arc lamps." G. B. BRYAN. January 9th.

436. "Improvements in mercury vapour lamps." O. D. LUCAS. January 10th.

446. "An apparatus for testing and indicating the intensity of electric currents in cables or other conductors." W. BRANFIELD. January 10th.

493. "Improvements in or relating to apparatus for measuring the strength or intensity of electric currents." O. T. BLATHY. January 10th. (Complete.)

512. "Improvements in and relating to electric generators." P. DAWSON. January 10th.

513. "Improvements in alternating-current commutator motors." A. P. ZANI. January 10th. (Complete.)

514. "An improved winding for electric motors, generators and the like." A. P. ZANI. January 10th. (Complete.)

521. "Improvements in secondary batteries." P. MEUSNIER and G. MOUNIER. January 10th.

522. "Improvements in and relating to electric oil switches." THE BRITISH THOMSON-HOUSTON Co., LTD. (The General Electric Co., United States.) January 10th.

523. "Improvements in electric meters." THE BRITISH THOMSON-HOUSTON Co., LTD., and F. HOLDEN. January 10th.

530. "Improvements in or relating to electric railways and trains." H. COURTEEN. January 11th.

534. "Improvements in twin or double carbon arc lamps." VERITYS, LTD., and F. S. WORSLEY. January 11th.

535. "Improvements in and relating to the lighting of electrical lamps by a self-connecting pole." J. SMITH. January 11th.

540. "Improved electrically heated curling tongs." J. MACLEAN. January 11th.

542. "An improved electric switch or cut-out." J. MACLEAN. January 11th.

571. "A method of and apparatus for indicating or checking the efficiency of electric train or car driving." W. MCLELLAN and C. H. MERZ January 11th.

608. "Improvements in portable electric drilling machines." J. MACLEAN. January 12th.

617. "An improved construction of splicing ear for electric trolley wires or the like." T. E. R. PHILLIPS. January 12th.

618. "An improved method of controlling the feeding mechanism of electric arc lamps of the open and enclosed types." W. J. FRY. January 12th.

669. "Automatic current feeder for electric railways." R. DUCKWORTH, H. DUCKWORTH and D. KERR. January 13th. (Complete.)

693. "Improvements in and relating to electric incandescent lamps." S. H. PENNING. January 13th.

700. "Improvements in electric transformers for high tension currents." H. HEINICKE. January 13th. (Complete.)

718. "Improvements in and relating to reverse current electric cut-outs or circuit-breakers." THE BRITISH THOMSON-HOUSTON Co., LTD., and E. B. WEDMORE. January 13th.

740. "An improved inspection cover for sewerage manholes and lampholes also chambers in connection with gas, water, electricity or similar works." E. E. W. BUTT. January 14th.

766. "Improvements in and relating to sparking plugs." F. LUTZ. January 14th.

776. "Improvements in alternating current electro-magnets." A. P. ZANI. January 14th. (Complete.)

778. "Improved manufacture of accumulator plates." A. G. BLOXAM. (F. E. Polzeniuss and R. B. Goldschmidt, Belgium.) January 14th.

789. "Improvements in the electric heating of electrically-propelled vehicles." THE UNION ELECTRICITATS GESELLSCHAFT. (Date applied for under Patents Act, 1901, January 16th, 1904, being date of application in Germany.) January 14th. (Complete.)

795. "Improvements in microphones." F. F. BOUARIL. (Date applied for under Patents Act, 1901, January 28th, 1904, being date of application in France.) January 14th. (Complete.)

797. "Improved construction of electric fuse or cut-out apparatus." A. B TUBINI. January 14th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1903.

ELECTRIC TRANSMISSIONS OF ENERGY THROUGH SPACE. A. Artom. 23,488. October 29th.

OPERATING RAILWAY SIGNALS AND POINTS BY ELECTRICITY. E. M. T. Boddam. 23,715. November 2nd.

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ELECTRIC ARC LAMPS OR MERCURY VAPOUR LAMPS. C. O. Bastian. 24,023. November 5th.

MEMORANDUM FOR USE IN CONNECTION WITH TELEPHONES. J. A. Gamble 24,055. November 5th.

ELECTRICALLY CONTROLLED VALVES. O. Junggren. 24,144. November 6th.

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WINDINGS FOR DYNAMO-ELECTRIC MACHINES. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) 25,838. Nov. 26th.

ELECTRO-MAGNETIC CONTROLLING GEAR FOR ELECTRIC ARC LAMPS AND THE LIKE. A. Eckstein and A. E. Angold. 26,427. December 3rd.

ALTERNATING CURRENT INDUCTION MOTOR. L. J. Hunt and the Sandycroft Foundry Co., Ltd. 27,722. December 17th.

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